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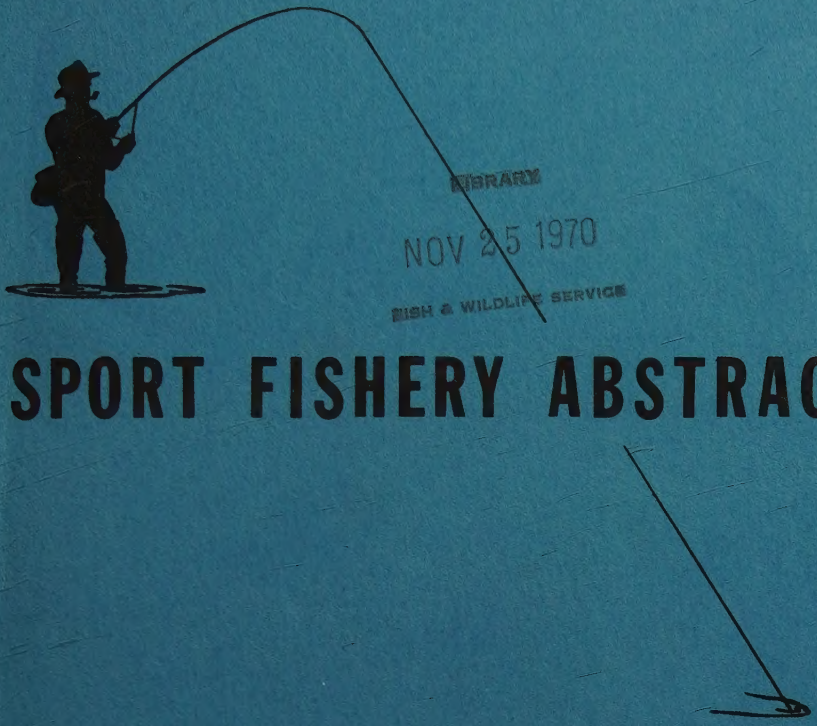

SPORT FISHERY ABSTRACTS

Vol. 15, No. 2, 1970

Abstracts 11863 - 12158

DEPARTMENT OF THE INTERIOR
U. S. FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE

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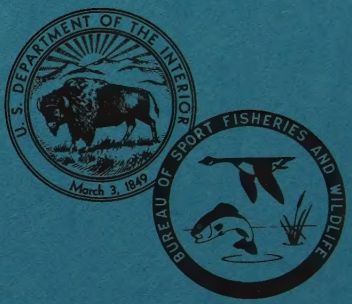

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Prepared in the Division of Fishery Research

Narragansett, Rhode Island

SPORT FISHERY ABSTRACTS

An abstracting service for fishery research and management

Vol. 15, No. 2 Abstracts 11863 - 12158 1970

Sport Fishery Abstracts is intended to furnish fishery biologists in government agencies and educational institutions with abstracts of the current literature in sport fishery research and management. Abstracts of published articles on limnology, ecology, natural history and other fields of specialization are included when the subject has application to the conservation and management of sport fishery resources.

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11863. Havey, Keith A., and Kendall Warner. 1970. THE LANDLOCKED SALMON (Salmo salar) ITS LIFE HISTORY AND MANAGEMENT IN MAINE. Joint Publication of Sport Fishing Institute, Washington, D. C. and Maine Dept. of Inland Fisheries and Game, Augusta, Maine, 129 p., Illus.

Among the renewable natural resources of Maine are its freshwater game fish populations. Of prime importance among these populations are those of the relatively rare but highly prized landlocked salmon (Salmo salar). With increasing usage, landlocked salmon populations can be expected to thrive and remain at satisfactory levels of abundance in proportion to the effort expended in maintaining the resource; vital to this effort are basic research, development of refined management techniques, and public education. The primary purpose of this paper is to summarize the status of the landlocked salmon in Maine. To fulfill this purpose we have attempted to: (1) summarize what has been learned; (2) point out what must be learned; and (3) outline approaches to future salmon management. Secondarily, we hope that technical personnel and administrators working to establish or maintain landlocked salmon populations in other locales will find the information of value to their particular programs. In compiling the report, we have drawn upon research already completed and research in progress in Maine. Some of the data from research in progress will be published later in greater detail and more refined form by those individuals actually conducting the work. Much of the data presented are from unpublished progress reports or raw field data. Citations for data from such sources are not presented but are available upon request from the Maine Department of Inland Fisheries and Game. (Authors introduction)

11864. Bogdanov, D. V., V. A. Sokolov, and N. S. Khromov. 1968. REGIONS OF HIGH BIOLOGICAL AND COMMERCIAL PRODUCTIVITY IN THE GULF OF MEXICO AND CARIBBEAN SEA. Oceanology (Okeanologiya), 8(3): 371-381.

Hydrological and hydrochemical conditions, plankton distribution, and the commercial possibilities of the common species of fishes in the Gulf of Mexico and the Caribbean Sea are discussed. Combined investigations have established the clear connection of high biological and commercial productivity with regions of upwelling and regions greatly influenced by continental runoff. In the former regions, the location of which remains relatively constant from season to season and year to year, the high productivity and commercial yield continue throughout the year and over a number of years. In the latter regions there are considerable seasonal and annual fluctuations in productivity, and commercial fishing is seasonal. Finally, certain recommendations are made on commercial possibilities in certain productive regions in the Gulf of Mexico and the Caribbean Sea.

11865. Bogorov, V. G. 1969. PLANKTON IN THE METABOLISM OF THE OCEAN. Oceanology (Okeanologiya), 9(1): 121-126.

The utilization by phytoplankton of various substances is described, and the available supplies of the latter are studied in relation to the scale of utilization. It is shown that there is selective utilization of the various chemical compounds brought down by rivers. Changes in the clarity of the water resulting from massive development of plankton are described, and the effect this has on the spectral composition of light at various depths is discussed. Finally, it is pointed out that the reciprocal effects of biological and nonbiological processes on one another are largely under the control of the living element.

11866. Chigirin, N. I., and A. G. Volochkov. 1969. THE IOAN SALINOMETER AND ITS BEST RESULTS. Oceanology (Okeanologiya), 9(1): 141-148.

The calibration and results of tests of the IOAN salinometer in the laboratory and at sea are discussed. An equation is derived for converting the salinometer readings into units of relative electrical conductivity. The sensitivity of the instrument is $0.0007^{o}/oo$, its accuracy is $\pm 0.003^{o}/oo$ of salinity and the output of the instrument is 12-15 samples per hour.

11867. Shushkina, E. A. 1968. CALCULATION OF COPEPOD PRODUCTION BASED ON METABOLIC FEATURES AND THE COEFFICIENT OF THE UTILIZATION OF ASSIMILATED FOOD FOR GROWTH. Oceanology (Okeanologiya), 8(1): 98-110.

Arising from an analysis of the author's own data and information in the literature it is assumed that the growth pattern of copepods is parabolic. On the basis of this assumption an approximate estimate is given of the rate of production of the Haloptilus longicornis population in the Fiji Sea. The production calculation was made by the physiological method. For possible variations in the coefficient of utilization of assimilated food for growth (K_2) and of metabolic level, the limits of variation of mean monthly P/B coefficients are around 0.6 - 4.0 for the example considered. Arising from the calculations it is considered that the physiological method may be used for approximate estimation of the rate of production of copepod populations when there is no information on the rate of reproduction and development of the crustaceans.

11868. Joseph, James, and Thomas P. Calkins. 1969. POPULATION DYNAMICS OF THE SKIPJACK TUNA (Katsuwonus pelamis) OF THE EASTERN PACIFIC OCEAN. Bull. Inter-Amer. trop. Tuna Comm., 13(1): 1-274.

Catches of skipjack tuna supporting major fisheries in parts of the western, central and eastern Pacific Ocean have increased in recent years; thus, it is important to examine the dynamics of the fishery to determine man's effect on the abundance of the stocks. A general linear hypothesis model was developed to standardize fishing effort to a single vessel size and gear type. Standardized effort was then used to compute an index of abundance which accounts for seasonal variability in the fishing area. The indices of abundance were highly variable from year to year in both the northern and southern areas of the fishery but indicated a generally higher abundance in the south. Data from 438 fish tagged and recovered in the eastern Pacific Ocean were used to compute growth curves. A least-squares technique was used to estimate the parameters of the von Bertalanffy growth function. Two estimates of the parameters were made by analyzing the same data in different ways. For the first set of estimates, K = 0.819 on an annual instantaneous basis and L_∞ = 729 mm; for the second, K = 0.431 and L_∞ = 881. These compared well with estimates derived using the Chapman-Richards growth function, which includes the von Bertalanffy function as a special case. It was concluded that the latter function provided an adequate empirical fit to the skipjack data since the more complicated function did not significantly improve the fit. Tagging data from three cruises involving 8852 releases and 1777 returns were used to compute mortality rates during the time the fish were in the fishery. Two models were used in the analyses. The best estimates of the catchability coefficient (q) in the north and south were 8.4×10^{-4} and 5.0×10^{-5} respectively. The other loss rate (X), which included losses due to emigration, natural mortality and mortality due to carrying a tag, was 0.14 on an annual instantaneous basis for both areas. To detect the possible effect of fishing on abundance and total yield, the relation between abundance and effort and between total catch and effort was examined. It was found that at levels of intensity observed in the fishery, fishing does not appear to have had any measurable effect on the stocks. It was concluded therefore that the total catch could probably be increased by substantially increasing total effort beyond the present level, and that the fluctuations in abundance are fishery-independent. The estimates of growth, mortality and fishing effort were used to compute yield-per-recruitment isopleths for skipjack in both the northern and southern areas. For a size at first entry of about 425 mm, the yield per recruitment was calculated at 3 pounds in the north and 1.5 pounds in the south. In both areas it would be possible to increase the yield per recruitment by increasing fishing effort. It was not possible to assess potential production of the skipjack stocks fished in the eastern Pacific, except to note that the fishery had not affected their abundance and that they were certainly under-exploited. It was concluded that the northern and southern stocks could support increased harvests, especially the latter. (Authors)

11869. Kume, Susumu, and James Joseph (Far Seas Fisheries Research Lab., Shimizu City, Japan). 1969. THE JAPANESE LONGLINE FISHERY FOR TUNAS AND BILLFISHES IN THE EASTERN PACIFIC OCEAN EAST OF 130°W, 1964-1966. Bull. Inter-Amer. trop. Tuna Comm., 13(2): 275-418.

Catch and effort statistics from the Japanese longline fishery operating in the eastern Pacific Ocean east of 130°W, from 1964 through 1966, were examined to study the geographic distribution, trends in apparent abundance, sexual maturity, and size composition of the tunas and billfishes. Yellowfin and bigeye tuna are generally most abundant in the equatorial regions of the high seas between about 10°N and 20°S, but west of 95°W. The marlins are more coastal in distribution, usually occurring to the east, and to the north and south of the heavy concentration of tropical tunas. Sailfish tend to be associated with coastal areas also, whereas shortbill spearfish are more frequently captured on the high seas. Swordfish are found most abundantly in the coastal regions off northern Mexico, and off northern Peru and southern Ecuador. The albacore, a temperate-water species of tuna, is most abundant in the high-seas area of the southeastern Pacific. Trends in apparent abundance were measured by the hook-rate (i. e. catch per 100 hooks). Hook-rates for bigeye tuna have decreased from about 3. 5 fish per 100 hooks in 1958 to about 1. 1 fish per 100 hooks in 1966. During the same period, effort was increased substantially and total catch has decreased since 1963. It does not appear that increased effort will result in sustained increased catches of bigeye. Hook-rates for yellowfin tuna in recent years have decreased to about one third of their initial levels. The surface fishery for yellowfin in the eastern Pacific apparently affects recruitment to the longline fishery. Assuming that present conditions in the surface fishery do not change appreciably, increased effort in the longline fishery probably would not produce sustained increased catches, but might in fact result in reduced catch rates. Unlike the situation for the other tunas of the eastern Pacific, it appears that the albacore fishery east of 130°W is not having a marked effect on their abundance. Although a high degree of variability was observed in the hook-rates for striped marlin, no obvious trends are evident. Catches have decreased slightly from 13, 500 tons in 1964 to about 11, 000 tons in 1966. Heavy fishing for sailfish began in 1964 with a hook-rate of 10. 6 fish per 100 hooks; by 1966 it had dropped to 5. 8. Catches of this species in the area of major concentration dropped from 329, 900 fish in 1965 to 173, 600 fish in 1966. This fishery has operated for too short a period of time to enable one to determine its effect on the sustainable yield. Length-frequency measurements and gonad samples from yellowfin and bigeye tunas collected in the eastern Pacific were analyzed to determine sexual maturity and growth characteristics. The results corroborate the findings of earlier investigators. (Authors)

11870. Kogan, B. A. 1968. MEASUREMENTS OF SEA WATER TEMPERATURE BY PHOTOTHERMOGRAPH. Oceanology (Okeanologiya), 8(1): 121-124.

A photothermograph used in automatic buoy stations is described. The probe is a mercury thermometer projected on a photographic film. The photothermograph has been found to be simple and reliable in use and capable of providing data on high frequency fluctuations of temperature over a long period.

11871. Rzhepishevskiy, I. K., I. A. Kuznetsova, and P. A. Vlasov. 1968. AN APPARATUS FOR MIXING WATER IN THE LABORATORY. Oceanology (Okeanologiya), 8(2): 280-282.

A simple device for mixing water in vessels is described. It is intended for use in studying the feeding of aquatic invertebrate filter feeders by maintaining the food particles in suspension.

11872. Fujinami, Norio. 1969. RESEARCH FLEET OF THE WORLD. FAO Fish. tech. Pap. No. 93, 197 p.

Includes: number of vessels by countries - floating vessels - underwater vehicles - floating platforms. Data on general characteristics - type of research - operative area - operating or controlled agency.

11873. Addis, James T., and Jack Erickson. . 1969. THE OHIO FISHERMAN. Ohio Dept. of Natural Resources, Division of Wildlife Publication 140, 31 p., Illus.

Some attitudes and characteristics of 4264 buyers of Ohio fishing licenses were determined by the replies to a mailed questionnaire. Compared with the average Ohio male, fishermen who responded were a little older, were better educated, earned a little more money, and were more apt to be married. The occupation areas of crafts, operations, management, and the professions were represented more frequently among fishermen than were farming, labor, service, clerical, and sales. About 39 percent of the respondents were from a rural background; only 22 percent presently live on farms or in rural areas. Most respondents preferred to fish from the shores of lakes and reservoirs. Nearly half did not fish for a particular species. When asked what they would prefer to catch, bass was listed as first choice by 45 percent, walleye by 15 percent. Most fishermen ate the fish they caught. About 87 percent fished with spinning or casting rods, and 86 percent used live bait. More than 50 percent spent at least half their fishing time with members of their family. Restrooms, camping areas, and parking lots were listed most frequently as the most desired convenience facilities which should be provided by fishing license monies. More than half the respondents stated they got as much enjoyment from a fishing trip even if they caught no fish. Stocking and restocking fish was listed by 33 percent as the most important responsibility of the Division of Wildlife. In order of decreasing frequency, the following other responsibilities were listed: providing convenience facilities, building new lakes, providing fisherman-access sites, fish research, enforcement, constructing fishing devices, removing rough fish, building spawning reefs, and controlling weeds. Although only 7 percent of the respondents listed research as the most important responsibility of the Division of Wildlife, 82 percent believed that fish management programs should be based on scientific studies. About 76 percent would approve a reciprocal license agreement between Ohio and other states. (Authors)

11874. Fee, Everett J. (Center for Great Lakes Studies, Univ. of Wisconsin-Milwaukee, Wisconsin). 1969. A NUMERICAL MODEL FOR THE ESTIMATION OF PHOTOSYNTHETIC PRODUCTION, INTEGRATED OVER TIME AND DEPTH, IN NATURAL WATERS. Limnology and Oceanography, 14(6): 906-911.

A numerical solution of Vollenweider's photosynthesis model is presented. This model provides for varying types and degrees of inhibition of photosynthesis by light. A digital computer is used to estimate the photosynthetic inhibition parameters and to integrate the model numerically over time and depth. The numerical approach exploits the full generality of the model by allowing the inhibition parameters to assume any values and by using the actual distribution of surface light over a day, thereby removing all the mathematical approximations made by previous authors. The assumptions and limitations of the solution and the data necessary to test it are discussed. (Auth)

11875. Maughan, Paul M. (Bur. of Commercial Fisheries, Washington, D. C.). 1969. REMOTE-SENSOR APPLICATIONS IN FISHERY RESEARCH. Marine Technology Society Journal, 3(2): 11-20.

Remote sensing, the measurement of some property of an object without having the measuring device physically in contact with it, is used to a limited degree in fishery research at the present time. Application of remote sensors to fishery research is examined in terms of direct and indirect detection of fish. Aerial photography and fish oil identification by spectroscopy form the basis information for the direct detection method; GEMINI photography has provided the data for the indirect detection method, that is, the delineation of ocean phenomena associated with concentrations of fish. (Auth.)

11876. Elliott, Francis E. (Washington Technical Institute). 1970. ON THE STATUS OF ELECTRIC FISHING. Marine Technology Society Journal, 4(1): 58-60.

The present status leaves no doubt that electric fishing is feasible but still quite far from its ultimate form. However, since feasibility has been proven, most of the remaining problems seem to be of a technical nature which could be solved by a straightforward developmental approach. The benefits which could be derived from such a radical improvement over present day fishing methods are quite clear. If research and development is carried far enough one can visualize, for instance, a fully automated platform which will not only attract fish, and catch them, but also will process them into fish meal, ready for shipment. This would be one way to help U. S. fishermen to recapture their share of the market. Up until about 10 years ago the United States ranked second only to Japan in world catch. Since then she has dropped to sixth place. During the same period she has become the largest and most lucrative market for fisheries products. The supply has come increasingly from imports. In 1950 imports provided 25. 1% of the supply and in 1966 65. 1%. In 1967 the net cost of imported fisheries products was $635 million. The largest imported item by volume was in fish meal. (Auth. summ.)

11877. Stoertz, George E., William R. Hemphill, and David A. Markle (U. S. Geological Survey, Washington, D. C.). 1969. AIRBORNE FLUOROMETER APPLICABLE TO MARINE AND ESTUARINE STUDIES. Marine Technology Society Journal, 3(6): 11-26.

An experimental Fraunhofer line discriminator detected solar-stimulated yellow fluorescence (5890 A) emitted by Rhodamine WT dye in aqueous solutions. Concentration of 1 part per billion was detected in tap water 1/2-meter deep. In extremely turbid San Francisco Bay, dye was monitored in concentrations of less than 5 parts per billion from helicopter and ship. Applications include studies of current dynamics and dispersion. Potential applications of the technique could include sensing oil spills, fish oils, lignin sulfonates, other fluorescent pollutants, and chlorophyll fluorescence. (Authors)

11878. Henderson, Croswell, Wendell L. Johnson, and Anthony Inglis. (Div. of Fishery Services, Bur. of Sport Fisheries and Wildlife, U. S. Dept. of the Interior, Fort Collins, Colorado). 1969. ORGANOCHLORINE INSECTICIDE RESIDUES IN FISH (NATIONAL PESTICIDE MONITORING PROGRAM). Pesticides Monitoring Journal, 3(3): 145-171, Map and Tables.

As a part of the National Pesticide Monitoring Program, fish were collected from 50 sampling stations located in the Great Lakes and in major river basins throughout the United States. Three composite samples, consisting of five adult fish of each of three species, were collected at all stations during the spring and fall of 1967 and 1968. The composite whole fish samples were analyzed by commercial laboratories for residues of 11 organochlorine insecticides. DDT and/or metabolites were found in 584 of the 590 composite samples, with values ranging to 45 ppm (mg/kg wet weight, whole fish). Dieldrin was found in 75% of the samples, with values ranging upward to nearly 2 ppm. Other organochlorine insecticide residues were found in fewer samples, but some had fairly high residue levels. Relatively high residues of DDT and metabolites, dieldrin, heptachlor, heptachlor epoxide, and chlordane were found consistently during all sampling periods at some stations. (Authors)

11879. Dryagin, P. A., P. L. Pirozhnikov, and V. V. Pokrovskiy (State Inst. of Lake and River Fisheries Research, Leningrad, USSR). 1969. POLYMORPHISM AMONG WHITEFISHES (Coregoninae), ITS BIOLOGICAL SIGNIFICANCE AND ECONOMIC IMPORTANCE. Problems of Ichthyology (Voprosy Ikhtiologii), American Fisheries Society, 9(1): 9-17.

Variations in individual whitefish species are described and compared; the exceptional degree of morphological differentiation existing within whitefish and cisco species demands some systematic rearrangement.

11880. Savvaitova, K. A. (Dept. of Ichthyology, Moscow State University, USSR). 1969. HOMOLOGOUS VARIATION IN CHAR SPECIES OF THE GENERA Salvelinus (Nilsson) Richardson AND Cristivomer Gill and Jordan. Problems of Ichthyology (Voprosy Ikhtiologii), American Fisheries Society, 9(1): 18-34.

The author analyzes homologous variation of characters in populations of the arctic char, S. alpinus (L.) from various regions of its distribution, and populations of related species [S. lepechini (Gmelin), S. drjagini Logaschov, S. malma (Walbaum), S. leucomaenis (Pallas), S. fontinalis (Mitchill)], as well as in the related genera Salvelinus and Cristivomer. Views are expressed on the causes of variation in chars, and their evolution is discussed. The reasons for the multiplicity of char forms are to be found in age differences, existence in unstable water systems, and the considerable variation in characters associated with adaptation to environmental conditions. Only three Salvelinus species can be regarded as well founded: S. alpinus, S. leucomaenis, and S. fontinalis. C. namaycush represents the most divergent branch of the chars.

11881. Shapiro, A. P., and V. L. Andreyev (Computer Center, Kuybyshev Far Eastern Polytechnic Institute, Vladivostok, USSR). 1969. OPTIMUM RELATIONSHIP BETWEEN ARTIFICIAL AND NATURAL REPRODUCTION FOR COMMERCIAL POPULATIONS OF FISHES. Problems of Ichthyology (Voprosy Ikhtiologii), American Fisheries Society, 9(1): 45-49.

The paper examines the best arrangements for control of the numbers of a fish population by regulation of the intensity of commercial fishing and artificial reproduction. The solution in the case of fishes with short life cycles and not spawning repeatedly can be arrived at analytically by means of Ricker's equation, $E_{i+1} = \alpha E_i e^{-\beta E}$, where E_i is the population density in the year i, and α and β are coefficients. For fishes with a spawning population made up of different age groups but not spawning repeatedly, some experiments with a mathematical model have been carried out by computer. A solution was found by selection of the best variant in accordance with the isopleth diagram of catches. Attention is drawn to conditions in which artificial breeding serves no useful purpose. The need for strict coordination of the activities of commercial fishery and piscicultural organizations is stressed.

11882. Ivankov, V. N., and V. L. Andreyev (Marine Biology Section, Far East Branch, Siberian Div. of the Academy of Sciences of USSR). 1969. FECUNDITY OF PACIFIC SALMON (GENUS Oncorhynchus spp.). Problems of Ichthyology, (Voprosy Ikhtiologii), American Fisheries Society, 9(1): 59-66.

Average absolute fecundity of Kurile Island salmon over a number of years has been found to be 1606 for the humpback (gorbuscha), 2557 for the Siberian salmon (keta), 1657 for the sima (masou), and 3635 eggs for the red salmon (nerka). Individual salmon populations differ sharply in absolute fecundity, but considerable degrees of overlap have been observed in the seasonal races of different regions. Each population has its own definite type of relationship between absolute fecundity and body-length. If it is accepted that the number of eggs changes with growth in proportion to the quantity of energy directed to generative metabolism (EG), and that $Q = \alpha Q^n - \beta Q^m$, where Q is EG, and α and β are coefficients, then, depending on the relationship between rate of growth and increase of EG, the change in absolute fecundity is in accordance with asymptotic, exponential and logistic functions.

11883. Jackson, Roy I. (FAO of the United Nations, Rome, Italy). 1968. INTERNATIONAL FISHERIES AND MARINE POLLUTION. In: International Conference on Oil Pollution of the Sea, Rome, 7th-9th October, 1968, Paper No. 1, pp. 26-49.

11884. FAO of the UN, Rome, Italy. 1969. REPORT OF THE IOFC WORKING PARTY ON STOCK ASSESSMENT IN RELATION TO IMMEDIATE PROBLEMS OF MANAGEMENT IN THE INDIAN OCEAN. FAO Fisheries Reports No. 82, 25 p.

11885. Cassinelli, G., E. Cotta, G. D'Amico, C. Della Bruna, A. Grein, R. Mazzoleni, M. L. Ricciardi, and R. Tintinelli (Farmitalia Istituto Ricerche, Milano, Italy). 1970. THAIMYCINS, NEW ANTHELMINTIC AND ANTIPROTOZOAL ANTIBIOTICS PRODUCED BY Streptomyces michiganensis var. amylolyticus var. nova. Archiv für Mikrobiologie, 70(3): 197-210.

A new microorganism, isolated in our laboratories and identified as Streptomyces michiganensis var. amylolyticus var. nova is described. Thaimycins can be obtained by submerged fermentation of this microorganism on a suitable culture medium. Three new related compounds, thaimycins A, B and C have been obtained and characterized by their physical and chemical properties. Data on the antiprotozoal and anthelmintic activities in vitro as well as in vivo are reported. (Authors summ.)

11886. Vladimirov, V. I. (Institute of Hydrobiology, Academy of Sciences of the UkrSSR, Kiev, UkrSSR). 1969. DEVELOPMENT AND HARDINESS OF CARP LARVAE AFTER EXPOSURE TO NAPHTHENIC GROWTH SUBSTANCE. Problems of Ichthyology (Voprosy Ikhtiologii), American Fisheries Society, 9(1): 79-85.

The effects of naphthenic growth substance (NGS) on the development and condition of carp larvae have been studied by exposure of the egg from the time of fertilization until about the end of the gastrulation stage, and of larvae during the first 11-16 days after hatching, with subsequent rearing in solutions up to the age of a month. Tested in quantities of 0.01, 0.1, and 1.0 mg/liter in many series of experiments, NGS was found to render the carp larvae much stronger; when used on progeny of poor quality, NGS stimulated the development of normal larvae, and the experimental larvae were much more uniform in size and included a much smaller number of individuals with retarded development and growth than the controls. Exposure of the egg to NGS had a much more stimulating effect on the vitality of the larva than exposure of the larva itself.

11887. Kotlyarevskaya, N. V. (Institute of Evolutionary Animal Morphology and Ecology, Academy of Sciences of the USSR, Moscow, USSR). 1969. THE HATCHING PROCESS IN THE PIKE (Esox lucius L.). Problems of Ichthyology (Voprosy Ikhtiologii), American Fisheries Society, 9(1): 85-94.

The development of the pike embryo during preparation for hatching and its morpho-physiological state during the actual process have been investigated. The functional states of the hatching glands and the adhesive glands have been examined. It has been shown that attenuation of the egg membranes by hatching gland secretion and embryo movement are important elements in the hatching process.

11888. Berdyshev, G. D., S. I. Baranova, and G. K. Korotayev (Institute of Biologically Active Substances, Far East Branch, Siberian Div., Academy of Sciences of the USSR, Vladivostok, USSR). 1969. CHANGE IN NUCLEIC ACID CONTENTS OF ORGANS AND TISSUES OF Oncorhynchus gorbuscha (Walb.) AT DIFFERENT STAGES OF ITS SPAWNING MIGRATION. Problems of Ichthyology (Voprosy Ikhtiologii), American Fisheries Society, 9(1): 112-119.

The nucleic acid content of certain organs and tissues of humpback salmon in the rivers of southern Sakhalin were determined at various stages in their spawning migration: in the sea just before entry into the rivers, in the rivers in the course of their migration to the spawning grounds, and after spawning. Possible variations in the results due to the employment of different methods of extraction and to the use of fresh or preserved material, or of dry residue were also investigated.

11889. Vasil'yeva, N. Ye., and V. M. Korovina (Dept. of Histology, First (Pavlov) Leningrad Medical Institute, and Laboratory of Ichthyology, Zoological Institute, USSR Academy of Sciences, USSR). 1969. COMPARATIVE HISTOLOGICAL STUDY OF THE INTESTINE IN SOME SALMONIDS. Problems of Ichthyology (Voprosy Ikhtiologii), American Fisheries Society, 9(1): 143-147.

11890. Cairns, John, Jr. (Dept. of Biology, Virginia Polytechnic Institute, Blacksburg, Virginia). 1970. NEW CONCEPT FOR MANAGING AQUATIC LIFE SYSTEMS. J. Wat. Poll. Contr. Fed., 15(2): 77-82.

The biologist has an important role to play if this planet is to be maintained viable while our industrial society continues to provide the essentials for the "good life." If biologists are to fulfill their role properly, a whole new set of capabilities must be developed. Some prerequisites for making full use of natural ecosystems without damaging them are in order: (1) Prediction systems, not only to predict catastrophe but also to predict the consequences of various types and intensities of environmental use. (2) Simulation techniques – the use of scale models to approximate various alternative uses of the environment so that consequences of all possible combinations and intensities of use can be estimated in the planning stages and the optimal beneficial combination of uses can be made. (3) Rapid biological information systems, both "in-stream" and "in-plant," which will permit environmental quality control to be maintained and will provide an early warning of impending environmental problems. (4) Aquaculture techniques that will enable biologists to restore degraded and damaged areas to a condition that will permit fuller beneficial use than is now possible and will enable biologists to make fuller use of an area where non-biological considerations have decreed that the natural environment must be altered drastically. (5) The identification of both the life support functions of our environment and the requirements of the environmental components essential to the maintenance of these functions. All of the above should be as quantitative as possible. This paper indicates that the methods and thought patterns of the past will not be adequate to meet the challenge of protecting our ecological life support system without endangering our industrial base.

11891. Barkuloo, James M. (Div. of Fishery Services, Alabama Cooperative Fishery Unit, Auburn Univ., Auburn, Alabama). 1970. TAXONOMIC STATUS AND REPRODUCTION OF THE STRIPED BASS (Morone saxatilis) IN FLORIDA. U. S. Dept. of the Interior, Bur. of Sport Fisheries and Wildlife Technical Paper No. 44, 16 p.

Striped bass from the Apalachicola and St. Johns Rivers in Florida were compared taxonomically with striped bass from other drainages on the Atlantic coast and Gulf of Mexico. Both the rivers contain endemic striped bass populations. The Apalachicola River population was found to be a separate race. Sexually mature striped bass from the St. Johns were induced to spawn using hormonal injections. Few fry were produced due to extreme temperature fluctuations. Reproduction requirements and factors limiting the abundance of striped bass in Florida are discussed. (Auth.)

11892. Yoshida, Howard O. (Bur. of Commercial Fisheries Biological Laboratory, Honolulu, Hawaii). 1969. EARLY LIFE HISTORY AND SPAWNING OF THE ALBACORE, Thunnus alalunga, IN HAWAIIAN WATERS. U. S. Fish Wildl. Serv. Fish. Bull., 67(2): 205-211.

Thirty-five juvenile albacore were found in the stomachs of 4,568 billfishes captured in Hawaiian waters between July 1962 and April 1966. Regressions of standard length on lengths of various segments of the vertebral column, determined from measurements made on 21 intact specimens caught in the Pacific Ocean, were used to estimate the lengths of the fragmentary specimens. A linear regression was used to describe the first year's growth of albacore. By use of the regression, expected lengths for various ages, in days, up to 1 year were obtained. One-year-old albacore were estimated to be 38 cm. in standard length. The spawning season for albacore in Hawaiian waters peaks in May and probably extends from March to September. (Auth.)

11893. National Wildlife Federation, The. 1970. CONSERVATION DIRECTORY. A LISTING OF ORGANIZATIONS, AGENCIES AND OFFICIALS CONCERNED WITH NATURAL RESOURCE USE AND MANAGEMENT. Publisher: The National Wildlife Federation, 1412 16th St., N. W., Washington, D. C. 20036, 140 p. price $1.50.

11894. Taylor, John L., and Carl H. Saloman (Bur. of Commercial Fisheries Biological Laboratory, St. Petersburg Beach, Florida). 1969. SOME EFFECTS OF HYDRAULIC DREDGING AND COASTAL DEVELOPMENT IN BOCA CIEGA BAY, FLORIDA. U. S. Fish Wildl. Serv. Fish. Bull., 67(2): 213-241, Illus.

Filling of 1,400 hectares (3,500 acres) of bay by hydraulic dredging has reduced the area of Boca Ciega Bay, Fla., by about 20 percent since 1950. An estimate of the annual standing crop destroyed is 1,133 metric tons (798 kg. per hectare, dry whole weight) of sea grass and about 1,812 metric tons (1,277 kg. per hectare, dry weight) of associated infauna. In terms of annual production, the loss of biological resources is far greater - minimum estimates are 25,841 metric tons of sea grass, 73 metric tons of fishery products and 1,091 metric tons of infauna exclusive of meiofauna. Natural areas remaining in the Bay support local and offshore fisheries and are of value for recreation, public utilities, commerce, and industry. At an estimated value of $988. per hectare per year, worth of the estuarine area already eliminated is $1.4 million annually. In addition, inestimable secondary losses occur, principally from sedimentation, turbidity, and domestic sewage. (Authors)

11895. Mosher, Kenneth H. (Bur. of Commercial Fisheries Biological Laboratory, Seattle, Washington). 1969. PHOTOGRAPHIC ATLAS OF SOCKEYE SALMON SCALES. U. S. Fish Wildl. Serv. Fish. Bull., 67(2): 243-280, Illus.

Photographic plates of sockeye salmon scales, with explanatory text, illustrate in detail the variations in scale features in this species. These illustrations of zones of freshwater and ocean growth (and of complete scales) can be used as: (1) standards to which scales under study may be referred for determination of age and race, (2) guides in choosing scale characters for racial and other studies, and (3) aids in the training of scale scientists. Examples of regenerated, resorbed, and other atypical scales are also shown. (Auth.)

11896. Ebel, Wesley J., and Charles H. Koski (Bur. of Commercial Fisheries Biological Laboratory, Seattle, Washington). 1969. PHYSICAL AND CHEMICAL LIMNOLOGY OF BROWNLEE RESERVOIR, 1962-1964. U. S. Fish Wildl. Serv. Fish. Bull., 67(2): 295-335.

The physical and chemical features of Brownlee Reservoir are discussed in relation to seasonal change, inflow and outflow, operation of the dam, modified environment of river below the dam, and possible effects of these factors on behavior, passage, and survival of salmon (Oncorhynchus spp.). Temperature, oxygen concentration, and current were the most critical factors affecting the distribution and survival of salmon. Water temperature above 26.7°C. and oxygen concentration below 3 p.p.m. limited the area of suitable habitat during midsummer; environmental conditions in the spring, fall, and winter were suitable, if not optimal. The reservoir had a significant effect on the temperature and oxygen concentrations of the Snake River below the dam. In October, discharge from the reservoir was 5°C. warmer than the water entering the reservoir; oxygen concentration was 5 p.p.m. lower than in the inflow. This condition reversed in June and July. Current velocities and directions changed significantly with changes in river inflow, discharge rate, and surface level of the reservoir. Passage by juvenile salmonids through the reservoir was affected by changes in reservoir temperature, length, oxygen concentrations, and velocity and direction of the current. (Authors)

11897. Green, Roger H. (Dept. of Zoology, Univ. of Manitoba, Winnipeg 19, Manitoba, Canada). 1970. GRAPHICAL ESTIMATION OF RATES OF MORTALITY AND GROWTH. J. Fish. Res. Bd Can., 27(1): 204-208.

A method is presented by which the individual growth rate and the population mortality rate can be estimated graphically in certain populations, given only knowledge of maximum individual size and of average size at two times of the year. The four graphs that are given may be used in several different ways, depending on the information available. (Auth.)

11898. Major, Richard L., and James L. Mighell (Bur. of Commercial Fisheries Biological Laboratory, Seattle, Washington). 1969. EGG-TO-MIGRANT SURVIVAL OF SPRING CHINOOK SALMON (Oncorhynchus tshawytscha) IN THE YAKIMA RIVER, WASHINGTON. U. S. Fish Wildl. Serv. Fish. Bull., 67(2): 347-359.

Egg-to-migrant survival for the 1957-61 broods ranged from 5.4 to 16.4 percent – the first estimates of survival of chinook salmon in a large river system. Spring chinook salmon spawn in the American, Bumping, and Naches Rivers and Rattlesnake Creek – tributaries of the Yakima River – and in the upper stretch of Yakima River proper. For both sexes, spawning fish in the upper Yakima River are smaller than those in the other areas. Mean lengths (mideye to end of hypural plate) were 45.5 and 57.3 cm. for the males and females in the upper Yakima River and 65.4 and 71 cm. for the males and females in the other areas. Spring chinook salmon migrate to sea in their second year. Larger fish migrate earlier in the season than do smaller fish. Seaward migration reaches a peak at Prosser, Wash., on the lower Yakima River between April 14 and May 19. Movement tends to be nocturnal. (Authors)

11899. Worlund, Donald D., Roy J. Wahle, and Paul D. Zimmer (Bur. of Commercial Fisheries Biological Laboratory, Seattle, Washington). 1969. CONTRIBUTION OF COLUMBIA RIVER HATCHERIES TO HARVEST OF FALL CHINOOK SALMON (Oncorhynchus tshawytscha). U. S. Fish Wildl. Serv. Fish. Bull., 67(2): 361-391.

A marking experiment was designed in which fall chinook salmon (Oncorhynchus tshawytscha) from 12 Columbia River hatcheries were marked in 4 consecutive years to estimate their contribution to the sport and commercial fisheries. The study was planned and is being executed by scientists of the Fisheries Research Board of Canada, Bureau of Commercial Fisheries, and fishery agencies of the States of Washington, Oregon, California, and Alaska. Sampling for marked fish is being conducted in most ocean fisheries for chinook salmon from Monterey, Calif., to southeast Alaska, as well as on the Columbia River. The 1963-66 returns from the first year's release (1961 brood) of 5.4 million marked fish make it possible to obtain a preliminary estimate of the contribution of the total hatchery releases as represented by this marked group. The estimated catch of 1961-brood fish that originated from the hatcheries under study was 287,326, or about 10 percent of the total catch of chinook salmon of that brood in the fisheries sampled. The estimated net value of this catch (to the fisherman) was about $1,900,000, whereas the cost to produce them was $831,000. The benefit to cost ratio was 2.3:1. The net value of the catch of fall chinook salmon of the 1961 brood that originated from all Columbia River hatcheries (including those not participating in the marking experiments) was estimated at $2,055,000. (Authors)

11900. Burgner, Robert L., Charles J. DiCostanzo, Robert J. Ellis, George Y. Harry, Jr., Wilbur L. Hartman, Orra E. Kerns, Jr., Ole A. Mathisen, and William F. Royce. 1969. BIOLOGICAL STUDIES AND ESTIMATES OF OPTIMUM ESCAPEMENTS OF SOCKEYE SALMON IN THE MAJOR RIVER SYSTEMS IN SOUTHWESTERN ALASKA. U. S. Fish Wildl. Serv. Fish. Bull., 67(2): 405-459.

An intensive research program was conducted in 1961 and 1962 by the Bureau of Commercial Fisheries Biological Laboratory, Auke Bay, Alaska, and the Fisheries Research Institute, University of Washington, with the cooperation of the Alaska Department of Fish and Game. Many sockeye salmon river systems were studied concurrently with essentially the same techniques so that systems covering the entire range of production levels could be compared. The general objective of this research was to determine the optimum escapement of sockeye salmon for each of the major systems. This was accomplished through integration of the results of several related studies: (1) summarization and analysis of historical and current data on runs of adult sockeye salmon, (2) delineation and description of spawning areas and estimation of their capacities, (3) delineation and description of the nursery areas and estimation of their capacities. The major

systems studied were the Wood, Kvichak, Naknek, and Ugashik systems, which enter Bristol Bay; the Chignik system, on the south side of the Alaska Peninsula; and the Karluk system, on Kodiak Island. Adult sockeye salmon in the commercial catches and escapements, and sockeye salmon smolts, were counted and sampled. Spawning grounds were surveyed to determine their size and quality and the distribution and abundance of spawners. Bathymetric maps were prepared for some of the nursery lakes. Intensive limnological studies, including a major effort to measure primary productivity, were made on many nursery lakes. Several types of gear sampled juvenile sockeye salmon and associated species in the lakes. Interim optimum or target escapements required for highest production on a sustained-yield basis have been established for each major system. (Authors)

11901. Novikov, G. G., and Yu. S. Reshetnikov (Institute of Evolutionary Morphology and Ecology of Animals, Academy of Sciences of the USSR, Moscow, USSR). 1969. BLOOD SERUM PROTEINS OF SALMONID FISHES. Problems of Ichthyology (Voprosy Ikhtiologii), American Fisheries Society, 9(1): 119-126.

The results of electrophoretic analyses of the blood serum proteins in some salmonid species (Coregonus, Atlantic salmon, Salmo ischchan, S. trutta, Salvelinus, and grayling) are described. Each species had its own characteristic distribution and content of protein fractions. Different types of Coregonus had the same protein fractions but in different proportions. The relative proportions of the different fractions tended to vary more than the composition, and different species sometimes had the same relative proportions.

11902. Girsa, I. I. (Laboratory of Lower Vertebrate Orientation and Signalization, Institute of Evolutionary Morphology and Ecology of Animals, Moscow, USSR). 1969. REACTION TO LIGHT IN SOME FRESHWATER FISHES IN THE COURSE OF EARLY DEVELOPMENT AND IN ALTERED PHYSIOLOGICAL STATES. Problems of Ichthyology (Voprosy Ikhtiologii), American Fisheries Society, 9(1): 126-135.

The experiments were carried out with larvae and fry of pike, Esox lucius L., roach, Rutilus rutilus (L.), Ovsyanka, Leucaspius delineatus (Heckel) (Cyprinidae) carp, Cyprinus carpio L., perch, Perca fluviatilis L., pike-perch, Lucioperca lucioperca(L.), and threespine stickleback, Gasterosteus aculeatus, L., and with mature ninespine stickleback Pungitius pungitius L. It has been shown that light reactions change from positive to neutral in the young when their mode of life and reception change. The process of adaptation to light may vary greatly in the same fishes. Reaction to light is an innate characteristic. A diurnal periodicity in reaction to light and a change in the reaction with satiation have been demonstrated.

11903. Anderson, R. B., and O. C. Fenderson (Maine Dept. of Inland Fisheries and Game, Augusta, Maine). 1970. AN ANALYSIS OF VARIATION OF INSECTICIDE RESIDUES IN LANDLOCKED ATLANTIC SALMON (Salmo salar). J. Fish. Res. Bd. Canada, 27(1): 1-11.

High variation in yearly samples of insecticide residues found in landlocked salmon from Sebago Lake, Maine, has necessitated an evaluation of sampling methods and an investigation of causes of variation. A sample of 59 male salmon, composed of ages III+, IV+, and V+, and representing fish in poor and good body condition was collected from a spawning run in the fall of 1967 and analyzed for DDT, DDD, DDE, dieldrin, and fat content. Levels of insecticide residues were found to be highly dependent on age and fat content. DDD and DDE increased with age and fat content, and dieldrin increased with fat content. Age and fat content were interdependent in their effects on DDT levels. DDT was significantly higher in high-fat than in low-fat fish at ages III+ and IV+ but not at age V+, showing a decrease with age among fish with high fat content and remaining constant with age among fish with low fat content. It is recommended that completely random selection of fish for insecticide analyses be abandoned in favor of stratification by sex, age, and fatness. Some of the possible causes of variation in insecticide content of salmon are discussed. (Authors)

11904. Zitko, V., D. E. Aiken, S. N. Tibbo, K. W. T. Besch, and J. M. Anderson (Fisheries Research Board of Canada, Biological Station, St. Andrews, N. B., Canada). 1970. TOXICITY OF YELLOW PHOSPHORUS TO HERRING (Clupea harengus), ATLANTIC SALMON (Salmo salar), LOBSTER (Homarus americanus), AND BEACH FLEA (Gammarus oceanicus). J. Fish. Res. Bd. Canada, 27(1): 21-29.

Yellow phosphorus is extremely toxic to aquatic life. In herring, salmon, and lobster, the toxic effect of phosphorus is irreversible and probably cumulative. For herring LT_{50} (hours) = $300/C^{0.87}$, where C = μg/liter of phosphorus. No clear indications of an incipient lethal level were found, an LT_{50} being obtained even at a concentration of 2.5 μg/liter. Incipient lethal levels of yellow phosphorus for lobster, salmon, and beach flea are 40 μg/liter, 18 μg/liter, and 3-4 mg/liter, respectively. Poisoned fish turn red and show signs of extensive hemolysis. Blood of lobster congeals, and after death the thorax may be filled with thick gel and the heart grossly distended. For lobster, LT_{50} (hours) = 300-0.17x, where x = product of phosphorus concentration and exposure time (μg days/liter). The oxidation of dispersions of yellow phosphorus in water is kinetically a first-order reaction with half-life of 2-7.5 hr. The adsorption of yellow phosphorus on a solid support such as bottom mud substantially decreases the rate of oxidation. (Authors)

11905. Moore, G. S., H. A. Peters, and R. E. Levin (Dept. of Public Health, Univ. of Massachusetts, Amherst, Massachusetts). 1970. ALTERATIONS IN THE ELECTROPHORETIC PROTEIN PATTERNS OF REFRIGERATED FISH. J. Fish. Res. Bd. Canada, 27(1): 31-38.

Expressible fluid was obtained from fillets on the 1st, 4th, and 14th days of refrigeration. The protein concentration was determined and electrophoresis using cellulose polyacetate strips was performed on each sample. The protein concentration remained constant between 6 and 8 g/100 ml over the 2-week period. Qualitative and quantitative examination of the densitometry tracings revealed that protein(s) having specific migratory characteristics were strongly associated with the duration of storage at 2C. (Authors)

11906. Tait, J. S. (Dept. of Biology, York University, Toronto, Ontario, Canada). 1970. A METHOD OF SELECTING TROUT HYBRIDS (Salvelinus fontinalis x S. namaycush) FOR ABILITY TO RETAIN SWIMBLADDER GAS. J. Fish. Res. Bd. Canada, 27(1): 39-45.

A method was developed for selecting hybrid trout for deep-swimming ability, for use in a breeding program to combine in one strain the early-maturing character of brook trout (Salvelinus fontinalis) with the deep-swimming ability of lake trout (S. namaycush) The method involves testing hybrids in pressure tanks and selecting individuals that, like lake trout, retain most of their swimbladder gas during the test period. For a sample of F_2 hybrids the range of pressures at which the fish floated when anaesthetized was almost entirely between the medians for samples of the two parent species. Successive tests of marked individuals showed good repeatability of flotation measurements. The method is concluded to be reliable for large-scale selection of fish with ability to retain swimbladder gas. (Auth.)

11907. Lindsey, J. K. (Fisheries Research Board of Canada, Biological Station, Nanaimo, B. C., Canada). 1970. EXACT STATISTICAL INFERENCES ABOUT THE PARAMETER FOR AN EXPONENTIAL GROWTH CURVE FOLLOWING A POISSON DISTRIBUTION. J. Fish. Res. Bd. Canada, 27(1): 172-174.

A use of the relative likelihood function is described. An example is provided to show exact statistical inferences about the parameter for an exponential increase in cell concentration when the concentration is a Poisson random variable. (Auth.)

11908. Tarr, H. L. A., and L. Gardner. (Fisheries Research Bd. of Canada, Vancouver Laboratory, Vancouver, B. C., Canada). 1970. DEOXYRIBONUCLEIC ACID POLYMERASE OF TROUT LIVER NUCLEI. J. Fish. Res. Bd. Canada, 27(1): 117-123.

The DNA polymerase of intact trout liver nuclei behaved similarly to that present in mammalian tissues in its mandatory requirement for four deoxynucleoside triphosphates, Mg^{2+}, and DNA primer. It was inhibited by DNase and pyrophosphate in comparatively low concentrations and by RNase and Actinomycin D in comparatively high concentrations. Soluble DNA polymerase was extracted from buffered suspensions of the nuclei by centrifugation at 100,000 g. It possessed properties very similar to those exhibited by the enzyme in intact nuclei. The polymerase activity of intact nuclei was increased by freezing and thawing, and the soluble enzyme was unstable at 30C and lost most of its activity in 1 day at 0C. The specific activity of the enzyme was 10-29 picomoles of deoxynucleoside triphosphate incorporated into DNA by 1 mg of protein in 1 hr at 25C. (Authors)

11909. Martin, N. V. (Ontario Dept. of Lands and Forests, Research Branch, Maple, Ontario, Canada). 1970. LONG-TERM EFFECTS OF DIET ON THE BIOLOGY OF THE LAKE TROUT AND THE FISHERY IN LAKE OPEONGO, ONTARIO. J. Fish. Res. Bd. Canada, 27(1): 125-146.

From 1936 to 1965 food content was examined in 17,171 Lake Opeongo lake trout (Salvelinus namaycush). The diet is analysed from the point of view of frequency of occurrence of foods, their weight, feeding activity of trout, size of trout and size of food, and seasonal and annual changes in food habits. In the late 1940's and early 1950's perch, Perca flavescens, largely disappeared from the diet. The lake trout initially turned to lake whitefish, Coregonus clupeaformis, and then to the cisco, Coregonus artedii, introduced into Lake Opeongo in 1948. As a result of these dietary changes lake trout are now heavier and rate of growth has improved. Age and size at maturity is later and there are fewer infertile fish. Egg counts, egg size, and ovary weights are now greater, particularly in the medium-sized lake trout. In the fishery the average weight of individual trout taken has almost doubled. About 25% more of the immature stock is exploited by the recent fishery. The harvest and catchability of lake trout has remained generally constant on a numerical basis but show an improvement on a poundage basis in the more recent years. The possible effects of these changes on the character of the fishery are discussed. (Auth.)

11910. Mawson, J. C., and R. J. Reed (Dept. of Forestry and Wildlife Mgmt., Univ. of Massachusetts, Amherst, Massachusetts). 1970. THREE COMPUTER PROGRAMS: BACK-CALCULATION, CONDITION FACTOR, AND STOMACH CONTENT, CDC 3600 FORTRAN/FORMAT. J. Fish. Res. Bd. Canada, 27(1): 156-157.

Three programs were developed to be used on the CDC 3600 computer at the University of Massachusetts: back-calculation, condition factor, and stomach content. They are written in standard Fortran IV notation, which can be adapted to any computer setup that accepts Fortran IV and has at least the storage capacity listed for each program. Instruction sheets and sample output can be secured from either author. (Authors)

11911. Reed, Dale F., and Edward B. Reed (Colorado Game, Fish and Parks Div., Glenwood Springs, Colorado). 1970. ESTIMATES OF SESTON CROPS BY FILTRATION WITH GLASS FIBER DISCS. J. Fish. Res. Bd. Canada, 27(1): 180-185.

Glass fiber filters were compared with centrifugation as a means of concentrating seston from a small fluctuating reservoir. Fifteen sets of samples drawn over a 2-month period showed that the filters removed about twice as much seston, by dry weight, as did the centrifuge. (Authors)

11912. Chen, T. R. (Dept. of Biology, Kline Biology Tower, Yale Univ., New Haven, Connecticut). 1970. FISH CHROMOSOME PREPARATION: AIR-DRIED DISPLAYS OF CULTURED OVARIAN CELLS IN TWO KILLIFISHES (Fundulus). J. Fish. Res. Bd. Canada, 27(1): 158-161.

A relatively simple and reliable in vitro methodology for fish chromosome study is described. A single cell suspension obtained by trypsinizing ovarian tissue was cultured for 5-7 days at 31C. The cells were treated with colchicine and hypotonic solutions then fixed in acetic-alcohol fixative. Air-dried preparations were made from these cells and were stained with aceto-orcein. Numerous metaphase plates unmarred by overlapping chromosomes were recovered and high quality karyograms were available for detailed karyotypic analysis. The general similarity of squash and air-dried karyotypes suggests that short-period cell culture preserves natural karyotypes. (Auth.)

11913. Khan, N. Y., and S. U. Qadri (Dept. of Biology, Univ. of Ottawa, Ottawa, Ontario, Canada). 1970. MORPHOLOGICAL DIFFERENCES IN LAKE SUPERIOR LAKE CHAR. J. Fish. Res. Bd. Canada, 27(1): 161-167.

Morphometric and meristic variations and ecological differences in 71 Lake Superior lake char, Cristivomer namaycush, from four localities confirmed that the lean lake char, C. n. namaycush, and the siscowet, C. n. siscowet, should be considered subspecies. They differed in four head characters and in mean numbers of anal fin rays and ribs. The siscowet and halfbreed differed in mean number of anal fin rays but not in any morphometric character studied. Differences between the humper and the three other forms were inconclusive. (Authors)

11914. Thiel, V., and H. H. Harvey (Dept. of Zoology, University of Toronto, Toronto, Ontario, Canada). 1970. PROPORTIONAL CONTROLLING OF WATER TEMPERATURES. J. Fish. Res. Bd. Canada, 27(1): 167-170.

In the regulation of water temperatures, it is now possible to improve on the conventional thermostat and the power switch it operates. This may be done through the use of a thermistor and a proportional controller. The latter supplies power to the heater in proportion to the difference between the temperature set on the dial and that measured by the thermistor. The result is exceptionally good temperature control with a minimum of mechanical problems. (Authors)

11915. Platt, T., E. Larsen, and R. Vine (Fish. Res. Bd. of Canada, Marine Ecology Lab., Bedford Institute, Dartmouth, N. S., Canada). 1970. INTEGRATING RADIOMETER: A SELF-CONTAINED DEVICE FOR MEASUREMENT OF SUBMARINE LIGHT ENERGY IN ABSOLUTE UNITS. J. Fish. Res. Bd. Canada, 27(1): 185-191.

The design, construction, and use of a self-contained submarine radiometer is described. The instrument measures the time-integral of the downwelling irradiance at a given depth in absolute units. The measurement error at 20 m in turbid coastal water is less than 5%. The instrument is useful in primary production and heat budget studies, and could find many applications in terrestrial ecology. (Authors)

11916. Warner, R. W., and S. C. Katkansky (Marine Resources Region, Calif. Dept. of Fish and Game, Menlo Park, California). 1970. AN INFLAMMATORY LESION IN AN AMERICAN SHAD, Alosa sapidissima. J. Fish. Res. Bd. Canada, 27(1): 191-193.

An adult male American shad, Alosa sapidissima, with an external swelling simulating a neoplasm was collected from the Russian River, California. Histological examination of the large cone-shaped protuberance disclosed it to represent chronic inflammation and repair in response to injury and infection. The combined findings suggest the lesion may have originated from a lamprey bite. (Authors)

11917. Dill, L. M., and T. G. Northcote (Dept. of Fisheries and Forestry of Canada, Vancouver, B. C., Canada). 1970. EFFECTS OF SOME ENVIRONMENTAL FACTORS ON SURVIVAL, CONDITION, AND TIMING OF EMERGENCE OF CHUM SALMON FRY (Oncorhynchus keta). J. Fish. Res. Bd. Canada, 27(1): 196-201.

In an experiment in incubation channels at Robertson Creek, B. C., survival of chum salmon from planting of eggs to emergence of fry was higher in large gravel (2-4 inches, 5.1-10.2 cm) than in small gravel (0.4-1.5 inches, 1.0-3.8 cm). Neither condition coefficient nor timing of emergence was affected by gravel size. There were no significant effects of egg burial depth (8 and 12 inches, 20.3 and 30.5 cm) or density (50 and 100 per treatment) on condition coefficient, or timing of emergence. (Authors)

11918. Shirahata, Soichiro. 1965. THE FEEDING OF RAINBOW TROUT FRY WITH NATURAL FOODS AND THE MAXIMAL GROWTH IN THEIR YOUNGER STAGES. Bull. Fac. Fish. Nagasaki No. 19, pp. 65-73, (In Japanese with Engl. abstract).

The present study was initiated to investigate to what extent the early growth of trout may be accelerated in growth management in trout farming. Three groups of 400 swim-up fry of rainbow trout were reared on diets of black fly larvae, Wilhelmia salopiensis, belonging to the family Simuliidae; planktonic crustacean Euphausia pacifica (frozen products), which are both known to be excellent diets for salmonids in nature; and horse liver (frozen products) as a control diet. The experiments were carried out at a temperature of 14°C for the first 78 days after the initial feeding. The fish were fed 15-20 times per day for the first 50 days and one to five times thereafter. Mortality was lowest in the group fed with liver and highest in that receiving Euphausia. The latter suffered 15% loss in number during the experiments and showed the poorest growth and also the poorest efficiency of food conversion. The distribution of their body length was greatest and cannibalism was frequently observed. Judging from these results, it can be concluded that Euphausia is unsuitable for the initial diet of trout. The group of trout fed with black fly larvae had the lowest mortality (4%) next to the group fed with liver and showed the best growth and a uniform distribution of their body size. The growth of the trout fed with this organism was close to the curve for maximal growth. Black fly larvae were found to be fairly easy for the trout to eat at the fry stage. Their gross efficiency of conversion averaged 6, which is similar to that of some other natural foods. The rates of growth of the three different groups were highest in the initial 10-day period, respectively, amounting to 6-8% daily. At that time the daily rates of feeding were estimated at about 30-40% (5-7% on dry basis) in terms of black fly larvae. In order that the fish over 1 g may grow at a rate close to maximal, it is necessary to maintain a daily rate of 3%. At such a rate, the body weight at a given time might be nearly doubled in 20 days. (Auth.)

11919. Ishihara, Tadashi, Koichi Kuwano, and Masato Yasuda. 1966. DETERMINATION OF CALCIUM BY CHELETEMETRY USING CALCEIN-II. DETERMINATION OF THE TOTAL CALCIUM AND THE DIALYSATE CALCIUM IN BLOOD SERUM. Bull. Fac. Fish. Nagasaki No. 20, 87-92, (In Japanese with Engl. abstract).

For the estimation of blood serum calcium, the YANAGISAWA method of colorimetry, and the chelate titration method with EDTA-2Na using Eriochrome Black T and Murexide as the indicators are generally used, but these methods are found to have some defects. The authors reported in a previous paper an improved method of chelate titration in which they used calcein, a kind of chelate indicator, to determine the conditions of estimation of calcium in drinking water and sea water. In our present experiment, this method has been employed for the estimation of total blood serum calcium and dialysate calcium, and it produced very satisfactory results. The method proved to be equal to the YANAGISAWA method in accuracy and far more advantageous due to its simple experimental operation and shortening of the time required. (Authors)

11920. Yasuda, Masato, Yoshitaka Yamazoe, and Tadashi Ishihara. 1965. STUDIES ON THE METABOLISM OF OXALIC ACID IN FISH MUSCLE-I. SEASONAL VARIATIONS AND INFLUENCE OF TEMPERATURE ON OXALIC ACID CONTENT IN FISH MUSCLES. Bull. Fac. Fish. Nagasaki No. 18, pp. 51-58, (In Japanese with Engl. abstract).

In the previous study on the formation of oxalic acid in fishes, a remarkable variation in the oxalic acid content according to the varieties of fishes and seasons was found. For thorough investigation of the cause, a year-long observation of the oxalic acid content was conducted on mutugoro (Boleophtalmus pectinirostris) and warasubo (Odontamblyops rubicundus) in which the influence of seasonal changes are very remarkable. Again, using the loach (Misgurnus anguillicandatus), the carp (Cyprinus carpio) and the crucian carp (Carassius auratus), similar variations were observed with artificially changed conditions of breeding temperatures ranging from 27°C to 5°C. The results suggested that the oxalic acid content was very high during summer, with instances of 120 mg% in the mutugoro and 40 mg% in the warasubo, and lowest in both cases in the winter during March. The patterns of variation in the content in both species were very similar, but no seasonal variation could be found in migratory fishes. This fact was observed also in the case of artificial variation of temperature, with a correlation between the content and the temperature. From these results, it was conjectured that there is a great probability that the oxalic acid content in fish muscles depends upon the state of activities in temperature environments. (Authors)

11921. Koga, Shigeyuki (Shimonoseki University of Fisheries). 1966. THE RELATIONSHIPS BETWEEN LENGTH AND WEIGHT OF TUNAS AND STRIPED MARLIN IN THE SOUTH PACIFIC OCEAN. Bull. Fac. Fish. Nagasaki No. 21, pp. 23-31, (In Japanese with Engl. abstract).

Data were obtained by the Koyo tuna fishing fleet in the Fiji area during the four-month period from August to November, 1958. At present the Fiji ground is restricted roughly to the area extending from 170°E. to 170°W. and from 18°S. to 30°S. The purpose of this report is to estimate the conversion equation between length and weight of albacore, Thunnus alalunga (BONNATERRE) and striped marlin, Makaira audax (PHILIPPI), caught in the Pacific Ocean. Therefore, for converting length-frequency data to weight-frequency data, the length-weight relationships derived from the regression of weight on length can be taken as: albacore; $w = 2.257 \cdot \ell - 3.198 \ldots$ (1), and striped-marlin: $w = 3.504 \cdot \ell - 6.737 \ldots$ (2) where ℓ is logarithm of length (cm) and w is logarithm of weight (1) in kg, (2) in kan . The body-weight of those with the same body-length differed by locations. The body-weight of albacore and yellowfin tuna caught in the area to the north of the equator showed a tendency to increase as the fishing ground proceeded eastward. The body-weight of albacore in the Fiji area (18°-30°S) is generally larger than that in the northwestern Pacific Ocean. The body-weight composition of albacore distributed in a location south of the equator is exactly identical with that on the same latitude north of the equator. In the South Pacific, the catch of the striped-marlin consists of large-sized ones. The principal group is composed of mature fishes with body-weight from 55 to 111 kg. However, fishes with body-weight from 23 to 36 kg are the leading group in the northwestern Pacific Ocean. In the area north of the equator, the length-weight relationship of bigeye tuna scarcely varied according to location and season. Therefore, for the purpose of converting length-frequency samples to weight-frequency samples, it seems that the statistics obtained from the total regressions are not affected by the difference in location or seasons. (Auth.)

11922. Shirahata, Soichiro. 1964. SOME OBSERVATIONS ON THE SWIMBLADDER HYDROPSY OF RAINBOW TROUT. Bull. Fac. Fish. Nagasaki No. 17, pp. 83-85, plate, (In Japanese with Engl. abstract).

The affected fish had distended abdomens and were floating listlessly near the water surface. Internally, the most characteristic symptom was swelling of the swimbladder which was filled with a grayish, turbid, transudative fluid. The

swimbladder sometimes reaches 60% of gross body weight. The fluid was found to be alkaline, its specific gravity being 1.010. Superficially, the other internal organs appeared normal. Although possibly-pathogenic, rod-shaped microorganisms were observed to be abundant in the fluid, the cause has not yet been determined. The occurrence of this disease is very rare in pond-raised rainbow trout. (Auth.)

11923. Shirahata, Soichiro. 1964. PROBLEMS OF WATER QUALITY IN FOOD TROUT PRODUCTION. Bull. Fac. Fish. Nagasaki No. 17, pp. 68-82 (In Japanese with Engl. abstract).

This paper deals with the variation of water quality between up- and downstream ponds in relation to their food trout production. The major part of the present investigations was conducted in the trout farms of Otomi Village, Yamagata Pref. in 1955 and 1956. Although they have produced rainbow trout at a rate of 150 tons per cubic meter per second of water flow annually, their production is considered to be near the maximum limit, because the more the ponds were located down stream, the more a time lag in production appeared and the lower the efficiency of production per unit of pond area became. The results of water analyses show that as the water flows down through the ponds, there is considerable decrease in dissolved oxygen, accompanied by reduction of the pH value, and increase in free carbon dioxide, ammonium and nitrite nitrogen, phosphates, suspended volatile matter and alkalinity. Under the conditions where the dissolved oxygen content was reduced to 3cc/l, "surfacing" behavior of trout was often observed, their feeding activity during the daytime being restricted. Further, under such environment, especially in downstream ponds, the blood corpuscle resistance of trout is decreased. However, where ample oxygen was present, even when 0.5 mg of ammonium nitrogen per litre was present, there was no difference in the blood resistance of trout between up- and downstream ponds. As a result, it can be said that the major factor involved in water quality in relation to trout production is dissolved oxygen, and its content should be maintained above 3cc/l. Rainbow trout fingerlings in their growing stages consume 230cc of oxygen, excreting 17 mg of ammonium nitrogen and 2.7 meq of substances which increase water alkalinity per kg of body weight per hour. Therefore, in anticipation of a possible relationship between oxygen consumption and rates of excretion, it was presumed that these relations might be available for the evaluation of the trout-pond environment. Thus, in the trout farms where the ponds were arranged in series and where trout were raised in great amount, the accumulation of ammonium nitrogen in the water was observed at a rate of 0.1 mg per 1cc decrease of dissolved oxygen. This value is close to 0.075 mg, which was determined in an experiment. On occasions when the rate of accumulation of nitrogen per unit decrease in oxygen might be higher than 0.1 mg, some consideration should be given to the rate of water change in the ponds, their sanitation, and the inflow of water containing nitrogenous substances. (Auth.)

11924. Miyahara, Shojiro, and Yoshiaki Tabata. 1964. A NEW GAS CHROMATOGRAPHIC METHOD FOR THE DETERMINATION OF SUCCINIC ACID AND OTHER DI-BASIC ACIDS IN TISSUE. Bull. Fac. Fish. Nagasaki No. 17, pp. 97-103, (In Japanese with Engl. abstract).

There have been various methods hitherto employed to determine the content of succinic acid in the tissue of aquatic animals, but the methods are troublesome. So far as we know, no reports have been made regarding the gas chromatographic method for the determination of succinic acid and other di-basic acids. The authors have found a method to determine these acids by gas chromatography, in which succinic acid contained in tissue, and other acids, are changed into dimethyl esters and dissolved in methanol, butanediol succinate polyester serving as the column. By this method we could obtain the graph of oxalic, malonic, succinic, glutaric and adipic acids. This method gives very reliable quantitative results without being disturbed by other substances when it is applied to tissue components. Baby clams and oysters contained 0.354 and 0.096 percent succinic acid respectively, but no oxalic, malonic, glutaric or adipic acid could be detected. (Authors)

11925. Tamura, Osamu, Mikio Kitadi, and Shindi Maeda. 1964. ON THE INFLUENCE OF SOME AGRICULTURAL CHEMICALS, ETC. ON THE HEMATOLOGICAL CHARACTERS OF FISH-I. Bull. Fac. Fish. Nagasaki No. 17, pp. 87-96, (In Japanese with Engl. abstract).

The effects of two kinds of agricultural chemicals on carp blood were measured. In the experiment on the effect of PCP, the specific gravity and the hematocrit value of the blood of fish in 0.05-0.3 ppm solutions increased together. With increase of the concentration of PCP, the erythrocyte sedimentation-rate decreased, while the hematocrit value and the specific gravity increased. In the experiment on the effect of Smithion, the specific gravity in 4 ppm and 6 ppm solutions decreased, while the hematocrit value and the specific gravity in an 8 ppm solution decreased together. With increase of more than 4 ppm in the concentration of Smithion, the hematocrit value and the specific gravity decreased. In a three-day experiment on the effect of the waste solution of the paper industry, the diluted concentration increased the specific gravity, but the dense concentration increased both the hematocrit value and the specific gravity. When carp, which had been bled or immersed in a solution of PCP, Smithion or waste solution of the paper industry, were placed into normal fresh water and fed for 3-15 days, the change of hematocrit value, specific gravity and erythrocyte sedimentation rate, which resulted from loss of blood or injury by the pesticides, reversed so as to return to normal. (Authors)

11926. Carter, James P., and Albert R. Jones. 1969. INVENTORY AND CLASSIFICATION OF STREAMS IN THE UPPER CUMBERLAND RIVER DRAINAGE OF KENTUCKY. Dept. of Fish and Wildlife Resources, Kentucky Fisheries Bulletin No. 52, 69 p.

The streams of fishery importance in the Upper Cumberland River Drainage of Kentucky were listed and classified on the basis of stream order. Some of the physical, chemical, and biological characteristics of the streams are described as well as the general characteristics of the fishery. Stream order provided a satisfactory means of classifying streams and selecting sampling areas when other factors influencing stream habitat were taken into consideration. Approximately 1,040 miles of stream in the drainage are considered to be of fishery importance but 440 miles (42%) are polluted. At least 16 streams totaling 387 miles in length have been degraded by a strip mine pollution – the most widespread and serious form of pollution in the drainage. Acid drainage from deep mines was found in 6 streams and gross sewage pollution occurred in one stream. Eighty-five species of fish representing 15 families were identified from 77 fish-population samples. The rock bass occurred in 58% of the samples and was the most frequently recorded species. The bluntnose minnow was the most numerous species while the coosa bass was the rarest species. (Authors)

11927. Farfante, Isabel Pérez (Bur. of Commercial Fisheries Systematics Lab., Washington, D. C.). 1969. WESTERN ATLANTIC SHRIMPS OF THE GENUS Penaeus. U. S. Fish. Wildl. Serv., Fish. Bull. 67(3): 461-591, Illus. Price $1.75.

Four subgenera of the genus Penaeus are described (Litopenaeus, Penaeus s. s., Fenneropenaeus, and Melicertus). Eight species and subspecies (P. setiferus, P. schmitti, P. duorarum duorarum, P. duorarum notialis, P. aztecus aztecus, P. aztecus subtilis, P. paulensis, and P. brasiliensis) are recognized as occurring in the western Atlantic. Synonymies are given. Lectotypes have been designated for two species, and the disposition of all types is shown. Diagnoses, detailed descriptions, and illustrations are presented for each species and subspecies. Geographic and bathymetric distributions are given. Affinities are discussed, and conclusions concerning ranges of variation and their spatial distribution are based on morphometric studies and other characters. The development of the external genitalia through the juvenile stage and the size range at which each taxon reaches the subadult stage are presented. Many details of ecology and life history are critically summarized and reviewed. A brief appraisal of the commercial importance of each form is also given. (Auth.)

11928. French, Robert R. (Biological Lab., Bur. of Commercial Fisheries, Seattle, Washington). 1969. COMPARISON OF CATCHES OF PACIFIC SALMON BY GILL NETS, PURSE SEINES, AND LONGLINES. Bull. Int. N. Pacif. Fish. Comm. No. 26, pp. 13-26.

Catches of salmon (Oncorhynchus spp.) on the high seas in 1963 by gill nets of different mesh size, purse seines, and longlines were compared. The species and size composition differed among the three types of gear. The purse seines generally took higher proportions of small sockeye salmon (O. nerka) and chum salmon (O. keta) than did the gill nets or longlines. Longlines took proportionately more of the larger salmon than did the gill nets or purse seines. Longlines did not always sample the small sockeye salmon caught by the other two types of gear. Gill nets caught fish of the widest range in lengths. Because they took salmon of sizes not caught by purse seines or longlines, gill nets probably best represent the size composition of salmon in the ocean. (Auth.)

11929. Dunn, J. R. (Biological Lab., Bur. of Commercial Fisheries, Seattle, Washington). 1969. DIRECTION OF MOVEMENT OF SALMON IN THE NORTH PACIFIC OCEAN, BERING SEA, AND GULF OF ALASKA AS INDICATED BY SURFACE GILLNET CATCHES, 1962-65. Bull. Int. N. Pacif. Fish. Comm. No. 26, pp. 27-56.

Directions of movement of sockeye (Oncorhynchus nerka), chum (O. keta), pink (O. gorbuscha), and coho (O. kisutch) salmon as indicated by surface gillnet catches in the North Pacific Ocean (north of 45°N), Bering Sea, and Gulf of Alaska are described by season for 1962-65. Included is an analysis of direction of movement of sockeye and chum salmon by age and stage of maturity. Mature sockeye salmon in the North Pacific Ocean from 160°W to 167°E, moved westward in May and June; mature sockeye salmon moved eastward in the eastern Bering Sea. In the central and western North Pacific Ocean movement of immature sockeye salmon was primarily westward to 170°E in July and August, and was easterly west of 170°E. In the fall, movement was quite variable in the central and western North Pacific Ocean. Winter movement of immature and maturing sockeye salmon was primarily eastward in the central and western North Pacific Ocean and in the western Bering Sea. Hypotheses on the oceanic migrations of sockeye salmon were not rejected by the present study. Near the central Aleutians in July and August of 1963, immature sockeye salmon tended to move west, and mature fish moved east. Among immature sockeye salmon, age .1 and age .2 fish moved in similar directions in the summer and fall of all years studied. Chum salmon maintained a westward movement in the Gulf of Alaska and in the central and western North Pacific Ocean, and an eastward movement in the eastern Bering Sea. Immature and mature fish were generally moving in a similar direction. Limited catches of mature pink salmon in the central and western North Pacific Ocean in the summer of 1962 and 1963 and of coho salmon south of Adak Island in the summer of 1963 indicated westward movement. (Auth.)

11930. Anas, Raymond E., and Sueto Murai (Marine Mammal Biological Lab., Bur. of Commercial Fisheries, Seattle, Washington). 1969. USE OF SCALE CHARACTERS AND A DISCRIMINANT FUNCTION FOR CLASSIFYING SOCKEYE SALMON (Oncorhynchus nerka) BY CONTINENT OF ORIGIN. Bull. Int. N. Pacif. Fish. Comm. No. 26, pp. 157-192.

The study of scale characters provides one method of determining the continental origins of salmon caught on the high seas. Three scale characters and a quadratic discriminant function were used to identify mature sockeye salmon (Oncorhynchus nerka) which originated in the North American and Asian continents. The fish were caught in the North Pacific Ocean and the Bering Sea. The method proved reliable. Variability not associated with real continental differences did not invalidate the method. For 1956-62, average errors of classification were 19 percent for samples collected in Bristol Bay streams and 27 percent for those collected in Asian waters. The results from seven years of data were consistently good. The error of classification ranged from 11.7 to 26.1 percent for samples from Bristol Bay and 21.3 to 36.7 percent for those from Asia. The method confirmed the east-to-west distribution

obtained from tagging - when applied to samples collected in 1962, it showed that Bristol Bay sockeye salmon predominated in the eastern Pacific Ocean and that Asian stocks predominated in the western Pacific. The results from the scale method agreed generally with those from a method based on morphological characters. (Authors)

11931. Tanaka, S., M. P. Shepard, and H. T. Bilton (Biological Station, Fisheries Research Bd. of Canada, Nanaimo, B. C., Canada). 1969. ORIGIN OF CHUM SALMON (Oncorhynchus keta) IN OFFSHORE WATERS OF THE NORTH PACIFIC IN 1956-58 AS DETERMINED FROM SCALE STUDIES. Bull. Int. N. Pacif. Fish. Comm. No. 26, pp. 115-156.

Scales of 13,289 mature chum salmon collected from various Asian and North American coastal areas from 1956 to 1959 and scales of 16,763 chum salmon collected in high seas areas of the North Pacific Ocean from 1956 through 1958 were examined for differences in scale characteristics. Within coastal areas, the numbers of circuli and spacing between them in the third and fourth year bands tended to vary with brood year, sex and age at maturity. Variations were less in the first and second year bands. Comparison of scales of chums from different coastal areas showed that those from British Columbia and Southeastern Alaska had many closely packed circuli in both the first and second year bands. Scales of chums from Northern and Western Alaska had fewer circuli but about the same year band widths in both the first and second year bands as did scales of British Columbia-Southeastern Alaska chums. Scales of chums from the Asian mainland (U. S. S. R.) had fewer circuli and smaller band widths for the first two year bands. First year circulus counts and band measurements of scales from Japanese chums were similar to those of North American chums, but second year counts and measurements were even smaller than those of chums from the U. S. S. R. There were no consistent differences in the characteristics of third year bands of chums from different areas. Using such differences in scale characteristics, coastal standards were established for four broad geographical regions - British Columbia-Southeastern Alaska (from Yakutat in Alaska southward to the southern limit of chum distribution in North America (Oregon) including Washington and Oregon States as well as British Columbia and Southeastern Alaska), Northern Alaska (the Gulf of Alaska coast north and west of Yakutat, and the Aleutian, Bering Sea, and Arctic Ocean coasts of North America), U. S. S. R. (including the Amur River and the Okhotsk Sea, North Pacific Ocean, and Bering Sea coasts of the U. S. S. R.), and Japan (Hokkaido and northern Honshu). A key was established wherein scale characteristics of chums sampled on the high seas were compared with similar characteristics of mature chums sampled in coastal areas. On the basis of these comparisons the chums sampled on the high seas were classified as originating in one of the four regions, or, where scale characteristics were not sufficiently distinct, as originating in either Asia or North America; some chums could not be classified either to region or continent of origin. Of chums sampled in coastal areas on which the key was based, 55.9% of those sampled in the British Columbia-Southeastern Alaska Region from 1956 to 1958 had scale patterns distinctive enough to identify their origin correctly if they had occurred among samples taken on the high seas. Similar percentages for other regions were: 18.2%, Northern Alaska; 29.0%, U. S. S. R. For three brood years the percentage of "identifiable" Japanese chums was low, averaging only 7.3%, but for two other years percentages were considerably higher (43.0% and 35.2%). The percentage of cases in which the region of origin would have been misclassified was low, averaging only 2.3%. Using the figures on percentages of identifiable chums from each region as a guide, scales of 16,763 chums taken by research vessels on the high seas during 1956, 1957 and 1958 were examined in an attempt to determine the origin of chums in different parts of the North Pacific Ocean and adjacent seas. During May and June, catches of chums were sparse in the Gulf of Alaska area and sampling was concentrated in the western parts of the North Pacific Ocean and Bering Sea. Most chums caught at this time were maturing fish. Among these maturing individuals, chums with

characteristic British Columbia-Southeastern Alaska scale patterns were restricted almost entirely to the Gulf of Alaska. There, samples with the highest fractions of British Columbia-Southeastern Alaska type fish were found in the eastern part of the Gulf relatively close to the coast. Later in the season (July to September), in all three years, British Columbia-Southeastern Alaska type chums formed high percentages of all samples from the northeastern part of the Gulf of Alaska and in a tongue extending westward in the Gulf between 50°N and 55°N to about 170°W. In most of these samples there were few mature chums from other regions and the percentages of British Columbia-Southeastern Alaska type chums present were almost as high as those of chums in the British Columbia-Southeastern Alaska coastal standards. On this basis it was concluded that in the late part of the season chums bound for the streams of North America from Southeastern Alaska southward formed the main part of the population of mature chums in the northeastern part of the Gulf of Alaska and in parts of the Gulf farther to the west as well. Immature chums contributed relatively few individuals to offshore samples collected during May and June, but formed the majority of the chums sampled from July to September. Immatures with scales of the British Columbia-Southeastern Alaska type occupied areas similar to those of the matures during both the early and late parts of the season. During May and June, mature chums classified as originating in the Northern Alaska Region formed substantial percentages of samples of mature chums taken in the eastern Bering Sea and along the northern coast of the Gulf of Alaska, adjacent to the spawning streams of the region. This area also contained some mature chums destined for other regions, but the percentages of these other chums were relatively small. It is concluded that the bulk of the mature chums in the eastern Bering Sea and northern Gulf of Alaska were bound for the adjacent Alaskan spawning grounds. Sampling in the southern and eastern part of the Gulf of Alaska was very spotty, but Northern Alaska type chums made substantial contributions only to one sample near 50°N, 145°W. Elsewhere in the southeastern Gulf of Alaska, Northern Alaska type chums were scarce. In the North Pacific Ocean and Bering Sea westward from 175°W, a few Northern Alaska type chums appeared in many samples, but in no case was the fraction large enough to suggest the presence of concentrations of Northern Alaska chums. Sampling from July to September showed Northern Alaska type matures to be present in substantial proportions in a number of widely scattered samples in the area eastward from 170°W and absent or present in only very small fractions in areas westward from 170°W. Almost no sampling was conducted in the eastern Bering Sea where Northern Alaska type chums had been particularly evident in May and June sampling. During May and June, Northern Alaska type chums formed only small percentages of the relatively sparse samples of immature chums sampled on the high seas. However, sampling later in the season (July to September) revealed that identifiable Northern Alaska chums made up substantial proportions of most samples of immatures in the southwestern part of the Gulf of Alaska (between 140°W and 165°W). Here, they were mixed with immatures bound for the adjacent British Columbia-Southeastern Alaska Region. During neither the May-June nor the July-September sampling period did Northern Alaska type immatures form substantial percentages of the chums sampled in the western North Pacific Ocean and Bering Sea. During May and June mature chums of the U. S. S. R. type formed relatively high percentages of almost every substantial sample of matures taken in the western North Pacific Ocean and Bering Sea, suggesting that U. S. S. R. chums formed the bulk of the population of matures in the western ocean area. In some samples south of the Aleutians percentages of U. S. S. R. type chums were smaller. In the eastern Aleutians and eastern Bering Sea, where Northern Alaska type chums formed high percentages of the samples, the percentages of U. S. S. R. type chums were low. Early in the season sampling in the Gulf of Alaska was very spotty; U. S. S. R. type chums contributed only small percentages to most samples but formed surprisingly large percentages of the maturing chums off the British Columbia coast. It is possible that these were mature chums bound for late-spawning streams in the U. S. S. R. within the same season (e. g., the Amur River, where the coastal fishery peaks in September). However, the very long distance from the spawning grounds (the

closest stream in the U. S. S. R. was about 2, 000 miles or 3, 700 kilometers away) and the fact that most chums bound for the U. S. S. R. region spawn earlier in the season than those from other regions (most reach the U. S. S. R. coastal fishing areas in July and August) cast doubt on the validity of the classification of these fish. It is concluded that among maturing chums the abundant stocks destined for the streams of the U. S. S. R. dominated the population in the western North Pacific and Bering Sea throughout the May to September sampling season. Chums with U. S. S. R. Region scale types also contributed to some samples in the Gulf of Alaska and eastern Bering Sea, but their total contribution to samples in these areas was relatively small. U. S. S. R. type chums formed substantial fractions of most of the rather scanty samples of immature chums obtained during the early part of the sampling season, including those from the western North Pacific Ocean and Bering Sea, and the Gulf of Alaska. In the Gulf of Alaska, these U. S. S. R. chums were mixed extensively with immatures from North American streams. In the western North Pacific and Bering Sea, on the other hand, few immature chums from any other region could be identified. During the later part of the sampling season when immatures became more available to the sampling gear, U. S. S. R. type chums again contributed to most substantial samples throughout the North Pacific Ocean and Bering Sea. Identifiable Japan Region chums formed only a very small fraction of the chums sampled on the high seas and most were from the 1958 samples (composed mainly of chums from the 1954 brood year, whose scale patterns were more distinctive than those of the other brood years). Most identifiable Japan Region chums came from the area westward from 175°W. However, samples taken in two more easterly areas (immatures taken from the eastern Gulf of Alaska in the later part of the 1958 season and matures from the area south of Kodiak Island taken early in the season in 1956) contained fractions of Japan type chums among the highest in any area. (Authors summ.)

11932. Bagge, Pauli (Institute of Marine Research, Biol. Div., Bulevardi 9 A 7, Helsinki 12, Finland). 1969. THE SUCCESSION OF THE BOTTOM FAUNA COMMUNITIES IN POLLUTED ESTUARINE HABITATS. Limnologica 7(1): 87-94.

The benthic faunae of five polluted estuaries situated in the Baltic-Skagerak region have been compared. The localities represent a gradation from oligohaline to mixoeuhaline conditions. In all the salinity zones compared, wherever the oxygen content of the bottom water is low, limivorous or selective deposit feeding species predominate in the type species groups. In the oligohaline and β-mesohaline zones such species are mainly oligochaetes and chironomids, while in a more saline environment these are replaced by capitellids and spionids. The secondary succession of the benthic animal communities caused by pollution was shown to be a rapid process, especially in localities where the exchange of water is limited. (Auth. summ.)

11933. Pella, Jerome J., and Patrick K. Tomlinson. 1969. A GENERALIZED STOCK PRODUCTION MODEL. Bull. Inter-Amer. trop. Tuna Comm. 13(3): 419-496.

A generalization of the Schaefer model is described which allows for skewness of the stock production curve relating production with population size. A fitting scheme is developed by which the stock production curve can be determined for an exploited population using only the catch and effort history of the fishery. Because of the extensive computations required in estimating the parameters, a computer program for use in the calculations is included. Examples are provided which demonstrate the suitability of the model for describing the dynamics of certain fish populations. In particular the catch and effort history for the yellowfin tuna fishery in the eastern Pacific Ocean is analyzed. (Authors)

11934. Ishida, Teruo (North Pacific Resources Div. Far Seas Fisheries Lab., Hakodate, Hokkaido, Japan). 1969. THE SALMON GILLNET MESH SELECTIVITY CURVE. Bull. Int. N. Pacif. Fish. Comm. No. 26, pp. 1-12.

11935. Dambach, Charles A. (Natural Resources Inst., Ohio State Univ., Columbus, Ohio). 1969. CHANGES IN THE BIOLOGY OF THE LOWER GREAT LAKES. Bull. of the Buffalo Society of Natural Sciences, Vol 25, No. 1, p. 1-17, 19 ref.; Selected Water Resources Abstracts, 3(5): p. 28, 1970.

Dramatic biological changes have appeared in bottom fauna and among certain fishes of the lower Great Lakes. Of special significance is abundant increase, since 1959, of the midge Procladius, a supposedly more pollution-tolerant form, while Chironomus promosus has decreased, suggesting that pollution zones have extended further into the lakes. The mayfly is now rare. Benthic fauna is now dominated by oligochaetes and midges, with some fingernail clams, snails, and leeches on the increase. Chemical conditions probably provide a more reliable index to changes than plankton data, but are difficult to relate. Species composition, once dominated by diatoms, is now dominated by blue-green algae. Decline of certain high quality fishes, notably the blue pike and walleye pike, is largely responsible for the accelerated public interest in corrective measures. Relative significance of environment versus overfishing is debatable. Increase in eutrophication rate of the Great Lakes, especially Lake Erie, is significant. Human technology can so modify the environment that biological populations are significantly affected. Biologists with requisite knowledge, should develop better guidelines for weighing costs of each increment of degradation and each increment of improvement. -- Jones

11936. Brinkhurst, Ralph O. (Toronto Univ. Dept. of Zoology, Ontario, Canada). 1969. CHANGES IN THE BENTHOS OF LAKES ERIE AND ONTARIO. Bull. of the Buffalo Society of Natural Sciences, Vol. 25(1): 45-71, 11 fig. 21 ref.; Selected Water Resources Abstracts, 3(5): p. 38, 1970.

Species composition of chironomid and oligochaete fauna in deepest parts of Lakes Erie and Ontario and Georgian Bay is fairly consistent with Beeton's trophic classification of these three lakes. The bottom fauna of Lake Erie suggests a west to east gradient from extremely eutrophic to moderately oligotrophic conditions. A similar south to north gradient is, at least partly, a reflection of temperature. Lake Ontario fauna suggests oligotrophy with possibly an eutrophic shore zone. Oxygen determinations of 10 years ago would be valuable. In grossly polluted situations, numbers of oligochaetes stay high; representatives of other groups may be scarce. Commonest oligochaete under such conditions is Limnodrilus hoffmeisteri. Proportion of oligochaetes to other forms of life, and the percentage of Limnodrilus hoffmeisteri in relation to all oligochaetes may be guides to degree of organic pollution. Difficulties in discussing the chironomid fauna include problems of nomenclature and systematics. The bottom fauna, potentially a good indicator of qualitative change, has been studied only superficially in the past. Since hard parts of chironomid larvae preserve well in lake sediments, core analyses might provide information on whether the distributions represent recent developments. -- Jones

11937. Burke, W. David, and Denzel E. Ferguson (Dept. of Zoology, Mississippi State Univ., Mississippi). 1969. TOXICITIES OF FOUR INSECTICIDES TO RESISTANT AND SUSCEPTIBLE MOSQUITOFISH IN STATIC AND FLOWING SOLUTIONS. Mosquito News, 29(1): 96-101; Selected Water Resources Abstracts, 3(5): p. 39, 1970.

The toxicity of parathion, toxaphene, DDT, and endrin in static and flowing test solutions to resistant and susceptible strains of mosquitofish was determined. Mortality-concentration curves and time-mortality curves were constructed. In both static and flowing tests, mortality was greater in susceptible fishes than in resistant fishes. The toxicity of a given concentration of DDT, toxaphene, and endrin is greater in flowing solutions than in static solutions. Parathion does not produce the same mortality pattern in resistant fish as do DDT, toxaphene, and endrin. This is thought to result from the generation of a metabolite more toxic than parathion itself. This metabolite may be removed from the flowing system at a rate to preclude its buildup to toxic levels. The authors discuss the merits of static and flowing tests. -- Sjolseth

11938. Landrum, Betty J., and Thomas A. Dark (Biological Lab., Bur. of Commercial Fisheries, Seattle, Washington). 1968. THE DISTRIBUTION OF MATURE WESTERN ALASKAN AND KAMCHATKAN SOCKEYE SALMON (Oncorhynchus nerka) IN THE NORTH PACIFIC OCEAN AND BERING SEA. Bull. Int. N. Pacif. Fish. Comm. No. 24, pp. 1-110.

Since 1955, meristic characters of sockeye salmon have been studied as a means of identifying and determining the distribution of salmon populations on the high seas. Certain a priori information (from tagging studies, catch statistics, etc.) has indicated that the primary contributors of sockeye salmon to the ocean areas investigated are streams of the Kamchatka Peninsula and western Alaska. Through discriminant function analysis, the proportions of mature western Alaskan and Kamchatka Peninsula salmon in annual collections of high seas samples have been determined. Sampling was conducted over broad areas of the North Pacific Ocean north of latitude 49°N and in the Bering Sea during the spring and summer of 1956-62. The annual classification of samples has shown highly consistent dominance of salmon of one or the other continental type in certain ocean areas. Mature Kamchatkan sockeye salmon are numerically dominant in most samples taken from near the Kamchatka Peninsula eastward to approximately longitude 175°E in the Bering Sea and North Pacific Ocean. Western Alaskan sockeye salmon predominate in the Bering Sea from 175°E to 180° eastward to North America and in the North Pacific Ocean from 175°E to the western portion of the Gulf of Alaska. Intermingling of the continental stocks appears greatest in a longitudinal band between longitude 170°E and 180° in the North Pacific Ocean. (Authors)

11939. Umminger, Bruce L. (Dept. of Biology, Yale Univ., New Haven, Connecticut). 1969. PHYSIOLOGICAL STUDIES ON SUPERCOOLED KILLIFISH (Fundulus heteroclitus). II. SERUM ORGANIC CONSTITUENTS AND THE PROBLEM OF SUPERCOOLING. J. Exp. Zool., 172(4): 409-424.

To gain insight into the mechanism permitting Fundulus heteroclitus to survive subzero temperatures in a supercooled state, previously published data on inorganic components of the serum were complemented by studies on serum organic constituents in parallel groups of adult male killifish acclimated to various temperatures (30°C, 20°C, 10°C, 4°C, 2°C, -1°C and -1.5°C) in salt water under otherwise constant laboratory conditions. When the acclimation temperature was lowered from 20°C to -1.5°C, there was little or no change in levels of serum total non-protein nitrogen, total amino acids, urea and non-glucose free carbohydrates. Total serum protein levels were usually unaffected by the cold, but occasionally showed a decrease. Serum total cholesterol levels increased by 69% in the subzero cold, presumably due to an increased lipid metabolism. Whereas most serum constituents (organic and inorganic) showed only minor changes in supercooled F. heteroclitus, serum glucose levels increased from three- to sixfold. Serum glucose levels of 68 mg% in fish at 20°C increased to 460 mg% in sexually regressed fish at -1.5°C but to only 280 mg% in supercooled mature fish. It was suggested that the elevation of serum glucose in the subzero cold permitted survival in a supercooled state, presumably by retarding ice crystal growth on any ice nuclei that might form spontaneously in the blood. (Auth.)

11940. Prophet, Carl W. (Kansas State Teachers College, Emporia, Kansas). 1970. LIMNOLOGICAL FEATURES OF LYON COUNTY LAKE AFTER DRAINAGE AND REFLOODING. The Southwestern Naturalist 14(3): 317-335.

Lyon County Lake was drained during the early fall, 1962, as the initial step in a program to rehabilitate its fishery. Beginning in March, 1963, and continuing through June, 1967, variations in physiochemical conditions, primary productivity, and the relative abundance and composition of zooplankton were recorded for the purpose of determining changes in these features during and immediately following reflooding. The annual mean dissolved oxygen, phosphate, specific conductance and gross primary productivity during the final year of the study were significantly lower than previously recorded values. Twenty species of Cladocera and fifteen species of Copepoda have appeared in townet samples. In general, density and biomass decreased throughout the study. Initially, Cladocera were approximately

twice as abundant as the Copepoda; however, by the final year of the study, their densities were approximately equal but Copepoda biomass was nearly double that of the Cladocera. (Auth.)

11941. Buffalo Society of Natural Sciences, N. Y.; and State Univ. of New York, Buffalo. Research Foundation. 1969. PROCEEDINGS OF THE CONFERENCE ON CHANGES IN THE BIOTA OF LAKES ERIE AND ONTARIO. Bull. of the Buffalo Society of Natural Sciences, 25(1): 84 p.; Selected Water Resources Abstracts, 3(5): p. 38, 1970.

11942. Murawski, Walter S. 1969. A STUDY OF THE STRIPED BASS, Morone saxatilis, FOULHOOKING PROBLEM IN NEW JERSEY WATERS. New Jersey Dept. of Conserv. and Economic Development, Div. of Fish and Game, Bur. of Fisheries, Nacote Creek Research Station, Miscellaneous Report No. 4M.

Striped bass, Morone saxatilis (Walbaum), overwinter in the upper portion of a number of southern New Jersey tidal rivers. At such time they are vulnerable to the non-sportsmanlike practice of foulhooking. This practice generally takes place during the first and last portion of the legal fishing season (early to mid March and in late December). An early law enacted to halt foulhooking was found to be difficult to enforce because of the ambiguity of certain terms such as "jig" and "gig". This project was initiated to study the habits of the overwintering striped bass so that if this problem continues and/or increases, new legislation could be adopted to minimize this practice without unnecessarily restricting the non-foulhooking angler. During the winters of 1965-66, 1966-67, 1967-68 and 1968-69 project personnel followed the movements of striped bass in the Mullica River and attempted to foulhook them at every opportunity. Our general observations were that striped bass overwintered in that area of the river having less than 10 ppt. salinity, they chose not necessarily the deepest holes in the river but rather the deep areas out of the main current, they remained tightly schooled and moved only very little when the water temperature remained at 34°F. or less, they remained in the upper river, dispersed and moved more but were still foulhookable in water temperatures up to 40°F. Observations on the relationship between the air and water temperatures and past records of the New Jersey air temperatures indicate that it is very likely that New Jersey estuarine temperatures go below 41°F. during the first week of December and remain there until the third week of March. Based on this prediction of water temperature and the fact that striped bass generally do not vacate the ocean for their estuarine overwintering grounds until at least the fourth week of December it was recommended that in order to substantially reduce the opportunities for foulhooking without unnecessarily restricting the non-foulhooking angler the fishing season should open on the first day of spring and close on Christmas Eve. (Auth.)

11943. Baker, Jeremy T. P. (Marine Sciences Centre, McGill Univ., Montreal, Quebec, Canada). 1969. HISTOLOGICAL AND ELECTRON MICROSCOPICAL OBSERVATIONS ON COPPER POISONING IN THE WINTER FLOUNDER (Pseudopleuronectes americanus). J. Fish. Res. Bd. Canada, 26(11): 2785-2793.

Effects of high, medium, and low levels of copper on the morphology of winter flounder were investigated using routine histological techniques and electron microscope analyses. High and medium levels of copper resulted in fatty metamorphosis in the liver, necrosis in the kidney, destruction of the hemopoetic tissue and gross changes in gill architecture. Seven other structures and organs were examined for copper-induced morphological changes but none were found. Light microscope studies showed that low levels of copper caused an extracted appearance in gill lamellae; the epithelial layer appeared vacuolated; the basi-lamellar region was reduced in thickness. Lamellar mucus cells were few compared with control specimens and chloride cells appeared in their stead. Electron microscope study of gill lamella from fish exposed to low levels of copper confirmed vacuolation in the epithelial layer. Also found were myelinlike figures, various membrane-bound vesicles, and apical homogeneous layers of reduced thickness. Increased amounts of particulate matter adhering to the external surface of the epithelial cells were apparent. Chloride cells were found instead of mucus cells. (Auth.)

11944. Mackay, I., and K. H. Mann. (Dept. of Zoology, The University, Reading, England). 1969. FECUNDITY OF TWO CYPRINID FISHES IN THE RIVER THAMES, READING, ENGLAND. J. Fish. Res. Bd. Canada, 26(11): 2795-2805.

Egg production by two cyprinids in the River Thames at Reading, England, was studied quantitatively from January to June 1966. Roach (Rutilus rutilus) had a short spawning period, shedding all their eggs in one batch, whereas bleak (Alburnus alburnus) had a protracted spawning period and produced two or three batches of eggs. The relationship between egg numbers (Y) and age (X) for roach was given by log Y = 0.0840X + 3.2085; the estimated fecundity of a 6-year-old fish was 5157 with 95% confidence limits at 4725 and 5631. For bleak the relationship was log Y = 0.0564X + 3.5221, and the estimated fecundity of a 5-year-old fish was 6356 with 95% confidence limits at 5987 and 6776. Combining previously obtained data on population density with new data on sex ratio and percentage breeding in each age class, the population fecundity for roach was about 600 eggs/m^2 and for bleak about 3000 eggs/m^2. The roach population had lower fecundity than roach populations in other studies and there was some evidence that a proportion of females ceased egg production during the period of the study. The possibility that low fecundity was a response to food shortage is discussed. (Authors)

11945. Fessler, James L., and Harry H. Wagner. (Oregon State Game Comm., Research Div., Oregon State Univ., Corvallis, Oregon). 1969. SOME MORPHOLOGICAL AND BIOCHEMICAL CHANGES IN STEELHEAD TROUT DURING THE PARR-SMOLT TRANSFORMATION. J. Fish. Res. Bd. Canada, 26(11): 2823-2841.

This study was initiated to determine changes in chemical composition, coefficient of condition, and body morphology for juvenile steelhead trout for premigratory through postmigratory periods, January through July. Winter-run steelhead trout, originating from Big Creek and the Sandy River, in Oregon, were used as experimental animals. A discriminant analysis indicated the coefficient of condition and fork length were nearly as powerful in separating smolts from parr as were 10 morphological measurements. The parr-smolt transformation in winter steelhead is size-dependent and characterized by a marked decrease in body depth and coefficient of condition. Changes in depth measurements and coefficient of condition provided the most meaningful measure of morphological change at the time of parr-smolt transformation. During the migratory period, lipid content was substantially lower than in the premigratory period for migrant-sized fish ($\geq$160 mm) but remained relatively constant in nonmigrants ($\leq$ 159 mm) throughout all periods. Seasonal changes in moisture and protein levels occurred in the larger fish, although moisture and protein content for the smaller fish remained relatively constant. The amount of ash did not change within a size group. The coefficient of condition of migrant-sized fish declined continuously from February through May but increased in June and July. The mean coefficient of condition for nonmigrants declined from December through February, but remained relatively stable from March through June, with an upward trend in July. (Authors)

11946. Das, B. S., S. G. Reid, J. L. Betts, and K. Patrick. (Ontario Research Foundation, Sheridan Park, Ontario, Canada). 1969. TETRACHLORO-O-BENZOQUINONE AS A COMPONENT IN BLEACHED KRAFT CHLORINATION EFFLUENT TOXIC TO YOUNG SALMON. J. Fish. Res. Bd. Canada, 26(11): 3055-3067.

Evidence is given that tetrachloro-o-benzoquinone is involved in the toxicity of bleached kraft chlorination effluent (BKCE) to young Atlantic salmon, Salmo salar. The main experimental support was isolation of tetrachlorocatechol from whole BKCE and from a BKCE fraction toxic to salmon, after reduction of both with sodium borohydride. Tetrachloro-o-benzoquinone was shown to be toxic to salmon at low concentrations. Instability of the toxic component in BKCE and substantial loss of toxicity upon treatment of BKCE with sulfur dioxide agreed with the properties of tetrachloro-o-benzoquinone in water solution. (Authors)

11947. Riffenburgh, Robert H. (Scripps Institution of Oceanography, Univ. of California, La Jolla, California). 1969. A STOCHASTIC MODEL OF INTER-POPULATION DYNAMICS IN MARINE ECOLOGY. J. Fish. Res. Bd. Canada, 26(11): 2843-2880.

A nonstationary Markov chain was developed to analyze and model the passage of energy through an ecological system composed of the Pacific sardine, the northern anchovy, their competitors, their predators, and their prey; then to carry the model forward through time projecting the biomasses of the relevant species if anchovy or hake fisheries, or both, are begun. The model seemed to agree adequately with observed data. The hypothesis of some earlier work of the author that the abundances of populations could be completely controlled by fishing intensities was rejected. Although no measure was made of the robustness of the ecosystem, it was concluded to be relatively impervious to artificial pressures, although there was seen a measurable boundary beyond which the ecological interactions became unstable and the system collapsed. Specifically, based on 1950-59 data, the sardine catch was projected to stabilize in the vicinity of 20 metric kilotons per year. Overfishing did not seem to have been a cause of the sardine "disappearance." To maximize sardine catch, the introduction of anchovy and hake fisheries with annual catches limited to certain percentages (depending on the maximizing criterion) of abundances would double or triple sardine catch and stabilize the fishing industry, but sardines could not be reinstated as the most abundant species as a result of selective fishing. To maximize the combined catch of the three fisheries, annual catches of 30% and 20% (for all criteria) of abundances of anchovy and hake, respectively, would yield nearly 1800 metric kilotons of fish, although most of it would be of less commercial interest than the sardine. (Auth.)

11948. Chlebeck, Anne, and Gary L. Phillips. (Dept. of Zoology, Univ. of Minnesota, Minneapolis, Minnesota). 1969. HEMATOLOGICAL STUDY OF TWO BUFFALOFISHES, Ictiobus cyprinellus AND I. bubalus (Catostomidae). J. Fish. Res. Bd. Canada, 26(11): 2881-2886.

A hematological study was made based on 10 specimens each of the buffalofishes Ictiobus cyprinellus and I. bubalus (Catostomidae). Average results of analyses of selected blood characteristics of I. cyprinellus and I. bubalus, respectively, were: hemoglobin content, 7.8 and 8.5 g/100 ml; erythrocyte count, 1.08 and 1.28 millions/mm^3; hematocrit, 34.6 and 32.9%; mean corpuscular hemoglobin, 67 and 64 μμg; and leucocyte count, 23916 and 29004 cells/mm^3. Types of leucocytes noted were lymphocytes, neutrophils, "secretory granulocytes," eosinophils, and thrombocytes. No basophils were found. The secretory granulocyte is apparently derived from the neutrophil series. The status of the secretory granulocyte in buffalofishes is discussed with reference to pertinent literature. (Authors)

11949. McBride, J. R., and A. P. van Overbeeke. (Fisheries Res. Bd. of Canada, Vancouver Laboratory, Vancouver 8, B. C., Canada). 1969. HYPERTROPHY OF THE INTERRENAL TISSUE IN SEXUALLY MATURING SOCKEYE SALMON (Oncorhynchus nerka) AND THE EFFECT OF GONADECTOMY. J. Fish. Res. Bd. Canada, 26(11): 2975-2985.

Sockeye salmon (Oncorhynchus nerka) develop marked hypertrophy of the interrenal tissue during the period of sexual maturation and spawning. No differences were found between fish held in captivity and those that matured in their natural habitat. Feeding appeared to have an inhibitory effect, but did not prevent the hypertrophy. Gonadectomy of sexually mature fish resulted in a rapid involution of the hyperplastic interrenal tissue. On the other hand, gonadectomy, when performed in an early stage of sexual maturity, prevented the development of interrenal hypertrophy. The interrenal hyperplasia was not accompanied by apparent changes in the ACTH cells of the pituitary gland. Gonadectomy, however led to increased affinity of these cells for lead-hematoxylin, but this effect did not take place until after interrenal involution had commenced. The results are discussed and it is concluded that the hypertrophy of the interrenal at this time is caused by gonadal hormones, which may act directly on the adrenal homologue without mediation by the pituitary gland. (Authors)

11950. Kabata, Z. (Fish. Res. Bd. Canada, Biological Station, Nanaimo, B. C., Canada). 1969. REVISION OF THE GENUS Salmincola Wilson, 1915 (COPEPODA: LERNAEOPODIDAE). J. Fish. Res. Bd. Canada 26(11): 2987-3041.

The morphology of the genus Salmincola is reviewed and its relationship to the genus Achtheres examined. Four species of Achtheres are transferred to Salmincola: A. coregonorum, A. extensus, A. strigatus, and A. corpulentus. The taxonomy of the genus is based on new and more reliable criteria, mainly on the details of the appendages. The structure of the second antenna and of the maxilliped, as well as the type of the bulla, are regarded as best recognition marks. All species of Salmincola are redescribed with these criteria in mind and the genus is recognized as having 15 species. A key to the species is given. The genus is divided into two subgenera. Subgenus Salmincola (Salmincola) is parasitic mainly on Salmonidae and is distinguished by the well-developed claw of the maxilliped. Subgenus Salmincola (Brevibrachia) is parasitic exclusively on Coregonidae and is distinguished by the vestigial claw of the maxilliped. Species of Salmincola fall into one of three categories: circumpolar, continental, and bicontinental. The first category comprises five species: S. carpionis, S. edwardsii (parasites of Salvelinus), S. thymalli (parasite of Thymallus), S. extensus, and S. extumescens (parasites of the coregonids). The continental species are subdivided into Palearctic and Nearctic. There are seven Palearctic species: S. coregonorum, S. stellatus, S. lotae, S. cottidarum, S. nordmanni, S. strigatus, and S. jacuticus. Only one Nearctic species is known, S. siscowet. Two species are bicontinental: S. salmoneus has a distribution straddling the Atlantic Ocean and S. californiensis is a Pacific species, found in North America and Asia. (Auth.)

11951. Clayton, J. W., and J. H. Gee. (Fish. Res. Bd. Canada, Freshwater Inst., Winnipeg, Man., Canada). 1969. LACTATE DEHYDROGENASE ISOZYMES IN LONGNOSE AND BLACKNOSE DACE (Rhinichthys cataractae AND R. atratulus) AND THEIR HYBRID. J. Fish. Res. Bd. Canada, 26(11): 3049-3053.

Electrophoresis of tissue extracts of both longnose and blacknose dace reveals five isozymes corresponding to tetramers of heart and muscle type subunits. The species are readily distinguished by the greater electrophoretic mobility of longnose dace isozymes that contain heart type subunits. The F_1 hybrid displays the multiple band pattern expected in a fish able to produce two kinds of heart subunit. In addition a variant type of muscle lactate dehydrogenase has been detected in the longnose dace. (Authors)

11952. Knight, William (Fish. Res. Bd. Canada, Biological Sta., St. Andrews, N. B., and The Univ. of New Brunswick, Fredericton, N. B., Canada). 1969. A FORMULATION OF THE VON BERTALANFFY GROWTH CURVE WHEN THE GROWTH RATE IS ROUGHLY CONSTANT. J. Fish. Res. Bd. Canada, 26(11): 3069-3072.

The author contends that the parameters of any growth curve should be a direct description of the graphical appearance of the data. For growth that is even approximately linear this is not true of the von Bertalanffy curve in its usual form. On the above grounds, an alternate form of the von Bertalanffy curve for use in such instances is proposed. (Auth.)

11953. Leggett, William C. (Dept. of Biology, University of Waterloo, Waterloo, Ontario, Canada). 1969. PUGHEADEDNESS IN LANDLOCKED ATLANTIC SALMON (Salmo salar). J. Fish. Res. Bd. Canada, 26(11): 3091-3093.

A mature, male, pugheaded, landlocked Atlantic salmon (Salmo salar Linn.) was collected from Gambo Pond, Newfoundland, in 1964. Analysis of age, growth, and spawning histories for this specimen, relative to other members of the population, indicated that the pugheaded condition did not affect its ability to compete successfully. (Auth.)

11954. Snieszko, S. F. (Eastern Fish Disease Lab., Leetown (P.O. Kearneysville) West Virginia). 1969. FISH FURUNCULOSIS. U. S. Dept. of the Interior, Bur. of Sport Fisheries and Wildlife FDL-17, formerly Fishery Leaflet 467 of July 1958.

11955. Jhingran, V. G., and A. V. Natarajan (Central Inland Fisheries Research Inst., Barrackpore, West Bengal, India). 1969. DERIVATION OF AVERAGE LENGTHS OF DIFFERENT AGE-GROUPS IN FISHES. J. Fish. Res. Bd. Canada, 26(11): 3073-3076.

Fishes in general show much growth variation between years from environmental influences, food availability, and stock density, and this variation is especially more pronounced in the tropics. Average growth rate and average length at age of constituent age-groups of fish stocks, under the circumstances, appear more appropriate especially for yield computations. By the method elaborated in this note, the modal values of sizes of constituent age-groups (derived from Petersen's method of length-frequency analysis) as obtained each month for all months over a number of years (9 years, in the present case, covering the period 1957-65) are simultaneously plotted and this results in as many oblique rows as there are age-groups. Regression lines corresponding to the oblique rows of scatters of modal plots are statistically derived and used to read off the average lengths at ages. The slopes of the lines represent the average growth rates for the size ranges delimited by regression lines. (Authors)

11956. Manion, Patrick J. (Bur. of Comm. Fisheries, Biological Station, Marquette, Michigan). 1969. EVALUATION OF LAMPREY LARVICIDES IN THE BIG GARLIC RIVER AND SAUX HEAD LAKE. J. Fish. Res. Bd., Canada, 26(11): 3077-3082.

Bayluscide (5, 2'-dichloro-4'-nitrosalicylanilide) and TFM (3-trifluoromethyl-4-nitrophenol) were evaluated as selective larvicides for control of the sea lamprey, Petromyzon marinus, in the Big Garlic River and Saux Head Lake in Marquette County, Michigan. Population estimates and movement of ammocetes were determined from the recapture of marked ammocetes released before chemical treatment. In 1966 the estimated population of 3136 ammocetes off the stream mouth in Saux Head Lake was reduced 89% by treatment with granular Bayluscide; this percentage was supported by a population estimate of 120 ammocetes in 1967, an indicated reduction of 96% from 1966. Post-marking movement of ammocetes was greater upstream than downstream. (Auth.)

11957. Durkin, Joseph T., Wesley J. Ebel, and Jim Ross Smith (Bur. of Comm. Fisheries, Biological Lab., Seattle, Washington). 1969. A DEVICE TO DETECT MAGNETIZED WIRE TAGS IN MIGRATING ADULT COHO SALMON. J. Fish. Res. Bd. Canada, 26(11): 3083-3088.

A device that can be used for rapid detection and separation of migrating adult coho salmon marked as juveniles with magnetized wire tags was tested in November and December 1967 at the Minter Creek Hatchery of the Washington Department of Fisheries. About two-thirds of the test fish in the holding pond entered the structure; the device correctly separated 89% of the fish with tags and 99% of the untagged fish. Placement of this equipment in streams, fish ladders at dams, and in hatcheries, would facilitate removal of tagged specimens from the general population of fish. (Authors)

11958. LeTendre, Gerard C., and Clifford P. Schneider (New York State Conservation Dept., New York). 1969. AGE AND GROWTH OF MALE WALLEYES IN SPAWNING RUNS FROM BLACK LAKE, NEW YORK. N. Y. Fish Game J., 16(2): 136-144.

Walleyes from Black Lake were measured and jaw tagged, and scale samples were taken on the spawning runs each spring from 1961 to 1964. A sample of 711 males, in which only age groups III to IX were represented, was selected for a study of age and growth. The age III males on the spawning run were faster growing than the males which spawned first at age IV. The maximum length to be expected was calculated to be 17.7 inches. Growth of male walleyes compared well with that reported for other lakes of the northern United States. The data suggest that a negative correlation between year class abundance and growth exists in Black Lake. In years of poor growth the minimum rates of angling success were higher than in years when growth was better. (Authors)

11959. Houde, Edward D. (Dept. of Conservation, Cornell Univ., New York). 1969. DISTRIBUTION OF LARVAL WALLEYES AND YELLOW PERCH IN A BAY OF ONEIDA LAKE AND ITS RELATION TO WATER CURRENTS AND ZOOPLANKTON. N. Y. Fish Game J., 16(2): 184-205.

Walleye and yellow perch larvae were collected in Billington Bay on four days in 1967 to determine their distribution, and both zooplankton abundance and water currents were measured. Walleye larvae were progressively concentrated in the western third of the bay as the season advanced, but the distribution of perch larvae varied in response to changing winds. Larval walleyes were more abundant at a depth of 3 meters than at 2 meters when wind velocity exceeded 5 meters per second, but yellow perch were always more abundant at 2 meters. By altering depth distribution in response to wind, walleyes avoided the strong surface currents associated with high winds, and their distribution remained stable. Currents were usually westerly in direction at 2 meters and deeper, but surface currents closely paralleled wind direction. Yellow perch were nearer the surface and their distribution reflected the prevailing wind conditions by changing from day to day. Zooplankton distributions were variable from day to day and were not easily related to water currents in the bay. Although distributions of walleye and yellow perch larvae were usually different, a high positive partial correlation was noted between the two species when several environmental factors were held constant. Few significant correlations existed between larvae and zooplankton, and no relation between abundance of potential food organisms and fish larvae could be recognized. (Auth.)

11960. Finkelstein, Samuel L. (N. Y. State Conservation Dept., New York). 1969. AGE AT MATURITY OF SCUP FROM NEW YORK WATERS. N. Y. Fish Game J., 16(2): 224-237.

Ovaries and testes were examined from 849 male and 440 female scup collected from the Peconic Bays of eastern Long Island between June 1, 1964 and September 14, 1966. Based upon gross examination of the gonads for males and observations of the morphological characteristics of the eggs and the ovary weight-body weight relationship for females, it was determined that some scup were sexually mature at 2 years of age. The data also confirm that scup spawn in these waters between early May and mid-July. Age-frequency distributions for males and females are presently separated. (Auth.)

11961. Briggs, Philip T. (N. Y. State Conservation Dept., New York). 1969. THE SPORT FISHERIES FOR TAUTOG IN THE INSHORE WATERS OF EASTERN LONG ISLAND. N. Y. Fish Game J., 16(2): 238-254.

The sport fisheries for tautog in the inshore waters of eastern Long Island were studied between May 1 and November 30 from 1964 through 1966. Tautog were important to anglers in these waters both as a supplementary species during the summer and as the principal species in the fall. Anglers often fished for tautog when fishing for other species was poorer than expected. Eastern Long Island Sound from Truman Beach through Plum Gut was heavily fished for tautog. In the study area, the species generally ranked third in numbers of fish caught behind scup and winter flounder. Anglers fishing from rowboats and Greenport-based open boats fished for tautog to a greater degree than anglers using other fishing facilities. Although tautog were taken from May through November, the catch and catch per effort were greatest in the fall. The average size of tautog in the sport fisherman's catches was greatest in May, declined in the summer and increased in the fall. (Auth.)

11962. Green, David M., Jr., and James A. Reckahn (Dept. of Conservation, Cornell Univ., New York). 1969. LACTIC ACID LEVELS IN ADULT LAKE TROUT IN CAYUGA LAKE, NEW YORK. N. Y. Fish Game J., 16(2): 255-257.

The possibility of delayed mortality in fatigued lake trout following gill netting and tagging was investigated by determining blood lactic acid levels and by holding fish in pounds. Gill netting plus tagging raised lactic acid concentrations four-fold over the resting level but was not associated with increased mortality. (Authors)

11963. Briggs, Philip T. (N. Y. State Conservation Dept,, New York). 1969. A LENGTH-WEIGHT RELATIONSHIP FOR TAUTOG FROM THE INSHORE WATERS OF EASTERN LONG ISLAND. N. Y. Fish Game J., 16(2): 258-259.

During the period from May 1 through November 30 each year from 1964 to 1966, tautog (Tautoga onitis) were weighed and measured as part of a general survey of the sport fisheries for this species in eastern Long Island waters. A total of 3, 156 specimens, representing a sample of the catches landed by sport fishermen at rowboat stations at New Suffolk, Southold and Orient Point, were weighed to the nearest ounce (28. 3 grams) and measured to the nearest 5 millimeters (0. 2 inch). A length-weight relationship was calculated from the data using the method of least squares. The resultant formula, log W = 5. 9920 + 2. 9162 long L, where W is the weight in ounces and L is the total length in millimeters, is presented. Calculated weights at 25-millimeter (1. 0 inch) intervals are given. (Auth.)

11964. Loeb, Howard A., and William H. Kelly (N. Y. State Conservation Dept., New York). 1969. NATIONAL FAST TURQUOISE KS LIQUID AS A LONG TERM DYE MARK. N. Y. Fish Game J., 16(2): p. 260.

Twenty brown trout (Salmo trutta) averaging 84 grams in weight were cheek injected with National Fast Turquoise KS Liquid and held for observation at 47° F. When the test was inadvertently terminated at 8 months all marks were brilliant. Weight had increased 151 percent as against 154 percent for control fish. Dissection of several fish showed no dye in other than cheek-area tissues; dye dispersed from the site of injection had disappeared during the test. Comparison with numerous tests using National Fast Blue 8GXM indicates that the undispersed portion of a KS mark would last for a long time over a greater increase in growth. Of the two dyes, the KS Liquid provides a brighter and probably more durable mark. (Authors)

11965. Muir, B. S. 1970. CONTRIBUTION TO THE STUDY OF BLOOD PATHWAYS IN TELEOST GILLS. Copeia, No. 1, pp. 19-28.

Arrangement of the afferent and efferent branchial vessels is compared for 27 teleosts. In all, the afferent vessel is comprised of posterior and recurrent anterior branches and in all but two, the vessel passes some distance through the arch before branching. Filament afferents arise from the branches and not from the main vessel. Efferent branchial vessels are double for part of their length in all but one species. In tuna gills, valve-like flaps are found throughout the length of the afferent branches. The blood pathway through the secondary lamellae of tuna gills differs from the "network" described for other species. As many as 20 parallel branches distribute blood along the edge of a lamella and give rise to discrete groups of capillary-like branches which pass obliquely across the lamella. Growth of an individual lamella tends more to increase the number of these "respiratory units" than to increase their length. (Auth.)

11966. Short, Zella F., R. F. Palumbo, P. R. Olson, and J. R. Donaldson (College of Fisheries, Univ. of Washington, Seattle, Washington). 1969. THE UPTAKE OF I^{131} BY THE BIOTA OF FERN LAKE, WASHINGTON, IN A LABORATORY AND A FIELD EXPERIMENT. Ecology, 50(6): 979-989.

The distribution of I^{131} among the biota of Fern Lake, Washington, was compared in aquarium and field experiments. The samples for study in the laboratory were isolated in containers so that the water solution, and not food, was the major source of the radionuclide. The field experiment related the uptake of I^{131} by organisms isolated in containers to the accumulation by those with access to their usual sources of food. In the aquarium, the initial concentration of I^{131} was 8, 000 times the average concentration calculated for the lake experiment. Maximum concentration factors ranged from 1. 7 and 2. 6 for the muscle of trout and crayfish, respectively, to 280 for the "thyroid" of trout, 380 for Nitella, and 600 for an amphipod. I^{131} was not detected in a number of samples collected from the lake, but accumulation factors were as high as 1, 400 for Nitella clumps and 12, 000 for the "thyroid" of trout. Young microcrustaceans, which are able to accumulate iodine directly from water, were an important source of I^{131} for trout. (Authors)

11967. D'Aoust, B. G. (Naval Medical Research Inst., National Naval Medical Center, Bethesda, Maryland). 1970. THE ROLE OF LACTIC ACID IN GAS SECRETION IN THE TELEOST SWIMBLADDER. Comp. Biochem. Physiol., 32(4): 637-668.

Existing evidence for the mechanism of gas secretion into the swimbladder of fish suggests that lactic acid is produced by the gas gland tissue in the presence of high oxygen pressure and is responsible for the "single concentrating effect" which is multiplied by counter-current blood flow through the rete mirabile to produce the necessary gas pressure. The catabolism of the gas gland tissue of the vermilion rockfish, Sebastodes miniatus, a species whose ecological depth range extends down to 200 m, has been investigated under O_2 pressures up to 51 atm. Lactic acid was produced by the tissue throughout the range of pressures investigated, and no evidence of a Pasteur effect was found. CO_2 production by the tissue was similar and very low under both O_2 and N_2 and suggested that citric acid cycle enzymes and oxidative phosphorylation systems were very weak in this tissue. The maximum glycolytic rates observed were too low to account for pre- and post-rete differences in lactate concentration observed by other workers, and glycogen levels in the gas gland tissue (0•02 mg/mg dry wt.) could produce the observed arteriovenous differences in lactate for only a few minutes. The essential role of lactic acid in gas secretion was supported by injecting oxamic acid, a competitive inhibitor of lactic dehydrogenase, into the swimbladder of deflated fish; statistically significant differences in control and experimental groups in both amounts and relative percentages of gases secreted were observed. (Auth.)

11968. Kitchell, James F., and John T. Windell (Fish Physiology Lab., Dept. of Biology, Univ. of Colorado, Boulder, Colorado). 1970. NUTRITIONAL VALUE OF ALGAE TO BLUEGILL SUNFISH, Lepomis macrochirus. Copeia, No. 1, pp. 186-190.

Bluegills that were fed algae in addition to a maintenance level of animal food showed a slightly greater percentage increase in weight than comparable fish on maintenance of animal food alone. Those fish that consumed algae alone lost less weight than fasted controls. The relationships between food consumption and weight change for these groups appears most nearly proportional to measures of digestible caloric intake. In other words, bluegills do gain some nutritional value from algae. There is no evidence for a more efficient utilization of plant food when fed in combination with animal food. A 30 g bluegill required 13-14 digestible cal/g of body weight/day for maintenance at 20. 8°C or a total daily caloric intake of 390-420 digestible calories. This could be met by consuming 1. 65-1. 77 g of live Chara or an amount equivalent to 5. 5-5. 9% of the body weight. Observations in our laboratory suggest that this amount is near if not in excess of the maximum amount of live food a fish of this size could voluntarily consume during a 24-hr period. In addition, the amount of algae consumed by those fish fed ad libitum provides further evidence that bluegills neither will nor can consume enough Chara to meet metabolic requirements. (Authors)

11969. Magnuson, John J. 1970. HYDROSTATIC EQUILIBRIUM OF Euthynnus affinis, A PELAGIC TELEOST WITHOUT A GAS BLADDER. Copeia, No. 1, pp. 56-85.

Analyses were based on morphometric and body density measurements of Euthynnus affinis 31. 6-67. 8 cm fork length and on observations of the swimming behavior of E. affinis about 42 cm fork length and held in tanks of 7. 3 m diameter and 1. 1 m depth. The body density of wild fish (fresh material) was 1. 086 g/cc (n = 30) and the weight of the fish in sea water (ρ = 1. 025 g/cc) measured in dynes was equal to $0.596\ell^{3.14}$ where ℓ is fork length in cm. Variations in required lift resulting from variations in the density of sea water, density of fish, and the quantity of food in the gut were evaluated. Neutral bouyancy was not obtained by fat deposition as about 44% of the mass of E. affinis would have had to be fat. Weight of the fish was opposed by hydrodynamic lift produced primarily by the pectoral fins as the fish swam continuously. The pectoral fins were analogous to thin, cambered hydrofoils. They also were twisted and had positive dihedral

and variable angles of attack and sweepback. Their total lifting area included body area between them, and for fins swept back at 25° equaled $0.0134\ell^{2.13}$ cm^2. Lift produced by the pectorals would be anterior to the fish's center of gravity; an argument was developed that the peduncular keel also produced hydrodynamic lift behind the center of gravity and was necessary for longitudinal stability. When the pectorals were extended, the body had no angle of attack and since it had little camber, it probably produced no lift. Pectoral fins of fish observed at higher speeds had greater sweepback (25° sweepback at 56 cm/sec versus 52° at 126 cm/sec) and were extended less. At higher speeds when the pectorals were continuously appressed the body had an angle of attack and probably produced hydrodynamic lift anterior to the center of gravity. When the pectorals were extended rather than appressed, fish could swim 40-84 cm/sec slower and still maintain equilibrium. The effectiveness of each lifting hydrofoil was estimated by the percentage of the total lift that it produced, its surface loading, and its coefficient of lift. These measures varied with changes in swimming behavior. When pectoral fins were extended at their most efficient posture they were estimated to carry 80% of the fish's weight, had a surface loading of 1200 dynes/cm^2, and a lift coefficient of 0.8. The keel was estimated to carry only 20% of the fish's weight, but had a surface loading of 1500 dynes/cm^2 and a lift coefficient of 0.8. The lift coefficient of the pectorals was lower when sweepback of the pectorals was greater. When the pectorals were appressed the body was estimated to carry 70% of the fish's weight, had a surface loading of 220-230 dynes/cm^2 and a lift coefficient of 0.1-0.4. Computed minimum speeds required to keep from sinking increased with the fork length of the fish, but decreased relative to body length. The relation $V_{100} = 10\ell^{1/2}$ where V_{100} is minimum speed and ℓ is fork length was very similar to the function relating endurance speeds of other fishes to their lengths. It was argued that the minimum speed possible for E. affinis was so similar to the maximum endurance speeds of other fishes, that the behavioral, anatomical, and physiological specializations of E. affinis and other scombroids for efficient locomotion were associated with continuous swimming to maintain equilibrium rather than with high-speed "burst" swimming. (Auth.)

11970. Gibson, James R., J. Larry Ludke, and Denzel E. Ferguson (Mississippi State Univ., State College, Dept. of Zoology, Mississippi). 1969. SOURCES OF ERROR IN THE USE OF FISH BRAIN ACETYLOCHOLINESTERASE ACTIVITY AS A MONITOR FOR POLLUTION. Bull. of Environmental Contamination and Toxicology, 4(1): 17-23, 1 tab., 1 fig., 8 ref; Selected Water Resources Abstracts, 3(6): p. 35, 1970.

The practicality of using fish brain acetylocholinesterase (AChE) activity as a monitoring method for pollution was examined. Bluegill sunfish were taken from waters with no organophosphorus insecticide contamination and from laboratory waters containing parathion. Various regions of the brain differ in AChE activity, with the inferior lobe the highest and cerebral hemispheres the lowest. Brain AChE activities in 7 groups of bluegills were determined to study effects of prior treatment upon AChE determinations. One group was a control, 5 groups were subjected to different freezing and thawing procedures prior to examination, and one group was analyzed without the inferior lobe. Significant differences in AChE activity were found depending on the form of prior treatment. They suggest therefore that a monitoring method based upon a 10% depression in AChE activity can lead to erroneous conclusions, even under carefully controlled conditions. Mortality and recovery from organophosphorus poisoning are not necessarily related to the degree of AChE inhibition. AChE activity of a species fluctuates with time. The degree of AChE inhibition is not always related to amount of inhibitor or to length of exposure. -- Sjolseth

11971. Stunkard, Horace W. (The American Museum of Natural History, Central Park West at 79th St., New York, N. Y.). 1970. THE MARINE CERCARIAE OF THE WOODS HOLE MASSACHUSETTS REGION. Biol. Bull. 138(1): 66-76.

11972. Shepard, M. P., A. C. Hartt, T. Yonemori (Fisheries Research Bd. of Canada, Canada). 1968. SALMON OF THE NORTH PACIFIC OCEAN - PART VIII. CHUM SALMON IN OFFSHORE WATERS. Bull. Int. N. Pacif. Fish. Comm. No. 25, pp. 1-69.

Chum salmon spawning stocks are distributed widely along both the Asian and North American coast lines: in Asia from northern Kyushu Island, Japan, in the south to the Lena River on the Arctic Ocean coast of the U. S. S. R. on the north; and in North America from Oregon in the United States in the south to the Mackenzie River on the Arctic Ocean coast of Canada on the north. Asian chums are considerably more abundant than North American chums. In Asia, chums are distributed in approximately equal numbers between three general areas, the Kamchatka and Bering Sea coast area, the northwest Okhotsk coast area, and the area from Sakhalin Island and the Amur southward (including the Japanese islands). The former two areas accommodate mainly summer and early autumn spawners (August-September) and the latter mainly autumn spawners (September-December). In North America, chums are spread rather evenly along the Bering Sea and North Pacific Ocean coasts as far south as Oregon. Summer or early autumn spawners predominate from Vancouver Island (in Canada) northward and autumn spawners from there southward. In the spring following deposition, young chums emerge from the gravel. In short coastal streams the fry move directly to sea within a day or two, but in larger systems may remain in fresh water for up to several months. After reaching the sea, some chums may remain in coastal waters until mid-summer where they commonly grow to 15-20 cm. Nothing is known of the movements of chums during their first winter at sea, but by the following summer, young chums (length 30-40 cm) are found distributed broadly throughout the subarctic waters of the North Pacific Ocean and adjacent seas. Data on winter distribution in their second and succeeding winters at sea are sparse. Results of exploratory fishing and tagging in the spring and summer months indicate that many chums had left the northern waters of the Bering Sea and Sea of Okhotsk during the winter and were conducting a return northward migration as the seas warmed in the spring. Most chums spend two or three winters at sea before migrating to their rivers of origin to spawn. In May and June of their final year at sea, maturing chums are found throughout the subarctic waters of the North Pacific north of 40°N. At this time many travel close to the surface and are very available to surface fishing gear. In the area westward from 175°W they are subjected to an intensive high seas fishery by Japan. As the season progresses mature chums evacuate offshore areas and become concentrated in coastal waters where they are fished intensively as they approach the spawning grounds. Such substantial inshore fisheries are conducted by Canada, Japan, the United States, and the U. S. S. R. within their territorial waters. Experiments involving marking of young chums leaving streams with subsequent searches among returning adults suggest that most chums return to the river of their origin to spawn. Information on the origin of chums sampled on the high seas comes mainly from tagging but data on distribution based on racial differences in age composition and in scale characters are also useful. Based on studies during the April to September periods, the data indicate that chum salmon of Asian and North American origin intermingle extensively on the high seas at least from about 179°E to 140°W in the North Pacific Ocean and from about 177°E to at least 169°W in the Bering Sea. As indicated by both tagging and scale studies in the area westward from about 175°W, Asian chums were clearly in the majority whereas eastward from about 170°W North American chums were predominant in most areas. With respect to stocks originating in particular areas tagging results showed: Chum salmon bound for Japan are distributed widely throughout much of the Bering Sea and the North Pacific Ocean as far east as 140°W in the Gulf of Alaska. Many maturing individuals are present in the area south of the Aleutians and the Alaska Peninsula during April and May. Probably these chums migrate northwestward subsequently as the season progresses and are found along the south side of the Aleutian Chain, in the Bering Sea, and off east Kamchatka in June through August. The bulk of Hokkaido chums apparently approach Hokkaido from the north through the waters east of the Kuril chain, arriving in the vicinity of Hokkaido in October and November. Chum salmon bound

for the Amur River remain relatively close to the Asian coast, being found in the western Bering Sea only to about 177°E and only to about 171°E in the western North Pacific. Despite the fact that the time of spawning of the stocks from the two areas is not very different, the relatively restricted distribution of Amur River matures is in marked contrast to the extensive distribution of chums from Japan. Chum salmon bound for the northwest Okhotsk coast, west Kamchatka, Sakhalin Island, and the northern Kuril Islands were distributed similarly to those from Hokkaido, with substantial numbers being found in the mid-Aleutian area, the Bering Sea, and some even extending into the Gulf of Alaska (to 141°31'W). However, the timing of the runs is different and maturing chums bound for the Okhotsk area appear off the southeast Kamchatka and Kuril Island coasts much earlier (in May and June) than do Hokkaido chums (mainly July to September). Tagging in earlier years suggested that chums bound for west Kamchatka primarily utilized the northern passes of the Kuril chain whereas chums headed for the northwest Okhotsk coast and Sakhalin approached through both the northern and southern parts of the chain. Chums bound for east Kamchatka and the northern Bering Sea coast of Asia are distributed to the east of those destined for the tributaries of the Okhotsk Sea (including the Amur River), few being found in the waters off Hokkaido and the southern Kurils. Several recoveries have been made from taggings in the southern and central part of the Gulf of Alaska as far east as about 144°W. Chums bound for streams on the Bering Sea and Arctic Ocean coasts of North America are present in the eastern half of the Bering Sea and the Gulf of Alaska (mainly in the western part). Maturing individuals bound for the latter regions are abundant in the eastern Aleutian area in May and June. Here they are mixed with maturing chums bound for Asian streams, mainly those of east Kamchatka and the northern Bering Sea coast. The distribution of northern Alaskan chums is quite similar to that of chums bound for the adjacent Bering Sea coast areas of the U. S. S. R. Their western limit was about 174°30'E in the Bering Sea. Chums bound for the Gulf of Alaska are thoroughly mixed throughout the Gulf, and only rarely are found as far west as the mid-Aleutians. In general, in the Gulf they tend to be distributed farther to the north (and, of course, to the east) of chums which are bound for the Bering Sea coast producing areas of Alaska and the U. S. S. R. and for east Kamchatka. Chums from central and southeastern Alaska were found as far west as 176°40'W, whereas those bound for British Columbia were present as far west as 168°38'W. (Authors summ.)

11973. Ferguson, Denzel E., J. Larry Ludke, Mack T. Finley, and George G. Murphy (Mississippi State Univ., Mississippi). 1967. INSECTICIDE-RESISTANT FISHES: A POTENTIAL HAZARD TO CONSUMERS. J. Miss. Acad. Sci., Vol 13, pp. 138-140; Selected Water Resources Abstracts, 3(6): p. 35, 1970.

This study assessed the actual and potential hazard of an insecticide resistant population of mosquitofish to large-mouthed bass and green sunfish. When three susceptible large-mouth bass and 14 susceptible green sunfish were fed resistant mosquitofish (about 2 ppm DDT) one bass died after 131 days and sunfish died after 107, 111, and 121 days. The sunfish dying after 107 days had 28.17 ppm DDT. All bass and green sunfish in the control lot fed pesticide free mosquitofish survived. Resistant green sunfish survived after each consumed a live mosquitofish containing 24.93 ppm endrin; susceptible green sunfish died in 15.5 hours. Susceptible green sunfish died 2 hours after consuming live mosquitofish containing 1041.66 ppm endrin. Regurgitation failed to prevent death. The potential hazard of resistant fish to the food chain is described. Biological magnification of insecticides by higher trophic levels is discussed as is the ultimate possible danger to man. -- Sjolseth

11974. Wellborn, Thomas L., Jr., N. N. Fijan, and J. P. Naftel (Bur. of Sport Fisheries and Wildlife). 1969. CHANNEL CATFISH VIRUS DISEASE. U. S. Dept. of the Interior, Bur. of Sport Fisheries and Wildlife, Fish Disease Leaflet 18, 3 p.

11975. Buhler, Donald R., Mary E. Rasmusson, and W. E. Shanks (Fish-Pesticide Res. Lab., Bur. of Sport Fisheries and Wildlife, Columbia, Missouri). 1969. CHRONIC ORAL DDT TOXICITY IN JUVENILE COHO AND CHINOOK SALMON. Toxicology and Applied Pharmacology, Vol. 14, pp. 535-555, 12 tab. 5 fig.; Selected Water Resources Abstracts, 3(6): p. 37, 1970.

Technical and p, p'-DDT were incorporated into test diets and fed to juvenile chinook and coho salmon for periods as long as 95 days. Pure p, p'DDT was slightly more toxic to young salmon than was the technical DDT mixture. Chinook salmon appeared to be 2-3 times more sensitive to a given concentration of DDT in the diet than were coho salmon. The size of the fish greatly influenced toxicity, smaller younger fish being more susceptible to a given diet than larger older fish. The dose of DDT accumulated within the median survival time ranged from 27-73 mg/kg for chinook salmon and from 56-72 mg/kg for coho salmon. The extrapolated 90-dose LD50 for young chinook and coho salmon were 0.0275 and 0.064 mg/kg/day, respectively. Liver size decreased on prolonged feeding with DDT, and carcass lipid content was increased. A severe surface ulceration of the nose region appeared in coho salmon fed DDT over long periods. -- Sjoleth

11976. Colby, Peter J., and Larry T. Brooke (U.S. Bur. of Comm. Fisheries, Great Lakes Fishery Lab., Ann Arbor, Michigan). 1969. CISCO (Coregonus artedii) MORTALITIES IN A SOUTHERN MICHIGAN LAKE, JULY 1968. Limnology and Oceanography, 14(6): 958-960.

Cisco die-offs are common in the summer in certain lakes of northern Indiana and southern Michigan, along the southern boundary of the natural distribution of coregonine fishes. On 31 July and 1 August 1968, a cisco die-off on Halfmoon Lake, on the border of Washtenaw and Livingston Counties, Michigan, was investigated. Water temperatures and dissolved oxygen were measured at Halfmoon Lake and at nearby Pickerel Lake, which has a cisco population but no history of summer die-offs. In Halfmoon Lake dissolved oxygen was severely depleted in the hypolimnion and the thermocline; values ranged from 0.10 to 0.25 mg/liter in the hypolimnion, compared with 4.35 to 6.10 mg/liter in the epilimnion. The temperature of the epilimnion ranged from 23.0 to 23.3C. The low oxygen in the hypolimnion and thermocline apparently forced the ciscoes into the epilimnion, where they could not tolerate the high temperatures. For comparison with Halfmoon Lake, vertical oxygen and temperature measurements in Pickerel Lake were made on 1 and 23 August 1968. The oxygen-temperature profile indicated a thick "cisco layer" that extended from about 4 to 11 m on 1 August and from about 4 to 9 m on 23 August. Pickerel Lake has a substantial stock of ciscoes. Because no summer mortalities have been reported and a thick "cisco layer" was still present on 23 August, the environmental conditions obviously are more favorable for ciscoes here than in Halfmoon Lake. In view of the frequent cisco die-offs in Halfmoon Lake, how is the population maintained? The stocks could possibly be replenished by ciscoes from Blind Lake, which is connected to Halfmoon Lake by a channel. Perhaps some fish in the lake are not adversely affected by the causes of the die-off. It has been postulated that young ciscoes are more tolerant of high temperatures and low oxygen than are the larger and older individuals and that they can survive through hot summers in a thin stratum above the thermocline. An alternative possibility is that young-of-the-year ciscoes can acclimatize more rapidly than adults to rising temperatures during early summer. Studies in progress suggest that adult ciscoes are acclimatized to temperatures less than 10C in the hypolimnion of Halfmoon Lake; when the oxygen is depleted in this layer, they move to the epilimnion where they encounter their incipient upper lethal temperature (24C). (Authors)

11977. FAO of the United Nations. 1969. FAO DEPARTMENT OF FISHERIES LIST OF PUBLICATIONS AND DOCUMENTS 1948-1969. FAO Fisheries Circular No. 100 (Rev. 1). Publr: Food and Agriculture Organization of the United Nations, Rome, Italy.

11978. Purdom, C. E. (Ministry of Agriculture, Fisheries and Food, Fisheries Lab., Lowestoft, England). 1969. RADIATION-INDUCED GYNOGENESIS AND ANDROGENESIS IN FISH. Heredity, 24(3): 431-444.

Eggs of trout (Salmo trutta L.), plaice (Pleuronectes platessa L.) and flounder (Platichthys flesus L.) were successfully fertilized by spermatozoa exposed to cobalt-60 gamma ray doses of from 10^4 to 10^5 rad. Typical "Hertwig phenomena" were observed, with survival increasing with increasing dose, suggesting that the developing embryos at high radiation doses were gynogenetic. Gynogenetic embryos were of two types, corresponding closely to haploid and diploid syndromes in parthogenetic frogs. Haploidy of grossly abnormal trout gynogenomes and diploidy in near-normal gynogenomes were indicated by a comparison of nuclear sizes in late embryos. Viability of diploid gynogenomes was very low and the individuals were not completely normal but showed many minor abnormalities comparable to inbreeding effects in laboratory fish. The normal incidence of diploid as opposed to haploid gynogenesis was less than 1 percent, but this could be increased to 60 percent or more by application of a cold shock 20 minutes after fertilization. Cold shocks applied 40 minutes after fertilization were not effective. Cleavage times were similar for gynogenetic haploids, diploids and normal controls, and there was no evidence of delayed cleavage as in frog parthenogenesis. Androgenesis in irradiated flounder eggs produced only haploid embryos, whether the eggs were cold-shocked or not. It was concluded that diploid gynogenesis probably arises through fusion of a female pronucleus; and the second polar body which, with a low cross-over frequency in fish oocytes, would explain the low viability of fish gynogenomes. (Auth. summ.)

11979. Costa, Robert R., and Kenneth W. Cummins (Univ. of Pittsburgh, Pymatuning Laboratory of Ecology, Pittsburgh, Pennsylvania). 1969. DIURNAL VERTICAL MIGRATION PATTERNS OF Leptodora kindtii (Focke) (CRUSTACEA: CLADOCERA) IN A SHALLOW EUTROPHIC RESERVOIR. Internationale Revue der Gesamten Hydrobiologie, 54(4): 533-541.

The diurnal vertical migration pattern of Leptodora kindtii (Focke) in Sanctuary Lake, a section of Pymatuning Reservoir (Crawford County, Pa.) was examined over a four year period (1965-68). Changes in the relative numbers of animals at three specific depths (Surface, 0.5 and 1.0 Meter) occur with time. Surface changes appear to be of much greater magnitude, although highly significant differences exist at all three sampling depths. The pattern is influenced by differences in migration of immature, nonegg-bearing females (2-5 mm) and mature, egg-bearing females (6-15 mm). Temperature, light and oxygen concentration were examined as factors relating to the quantitative presence of Leptodora and depth of their occurrence. Of the three factors evaluated, light appears to play the dominant role. (Authors)

11980. Tsuyuki, H., and E. Roberts (Fish. Res. Bd. of Canada, Vancouver Lab., Vancouver 8, British Columbia, Canada). 1969. MUSCLE PROTEIN POLYMORPHISM OF SABLEFISH FROM THE EASTERN PACIFIC OCEAN. J. Fish. Res. Bd. Canada, 26(10): 2633-2641.

Muscle proteins of 897 specimens of sablefish, collected during 1963-67 in the northeastern Pacific Ocean, ranging from Unalaska Island, Alaska, to Cape Blanco, Oregon, were analyzed by starch gel zone electrophoresis. Without exception, all specimens fitted into one of three phenotypic protein patterns resulting from two polymorphic proteins appearing singly or in pairs. Hereditary control by two codominant alleles, Mu^A and Mu^B, is postulated to explain the heterogeneity of the muscle protein patterns. Phenotypic distribution was shown to be independent of age and sex. The collection was arbitrarily divided into 10 areas, and the gene frequencies used as population parameters suggested homogeneity but did not provide positive evidence of heterogeneity in the sablefish inhabiting the waters of the eastern Pacific Ocean. The implications of these results are discussed in the light of previously reported racial and tagging studies. (Authors)

11981. Glass, Norman R. (Environmental Systems Group, Inst. of Ecology, Univ. of California, Davis, California). 1969. DISCUSSION OF CALCULATION OF POWER FUNCTION WITH SPECIAL REFERENCE TO RESPIRATORY METABOLISM IN FISH. J. Fish. Res. Bd. Canada, 26(10): 2643-2650.

The rationale for employing a nonlinear iterative least-squares technique for fitting the well-known power function to oxygen consumption-body weight data is set forth. Twenty-six sets of routine or standard metabolism data from six authors were used to demonstrate the relative merits of two methods of calculating parameter values for the power function. The conclusion was reached that if accuracy in predicting oxygen consumption over a wide range of values of body weight is desired, an iterative curve fitting method may be superior to the much used technique of performing a linear regression on logarithmically transformed data. (Auth.)

11982. McCombie, A. M., and A. H. Berst. (Ontario Dept. of Lands and Forests, Research Branch, Maple, Ontario, Canada). 1969. SOME EFFECTS OF SHAPE AND STRUCTURE OF FISH ON SELECTIVITY OF GILLNETS. J. Fish. Res. Bd. Canada, 26(10): 2681-2689.

Selectivity curves for three species of fish taken in South Bay, Manitoulin Island, and in Georgian Bay during 1954-59 with gangs of nylon gillnets differed with respect to mode, skew, and kurtosis. A graphic method was developed to describe one aspect of body shape, namely the relation between girth and distance from the snout, which would affect selectivity. Surprisingly, the shapes of mature (but not gravid) and immature perch and suckers of both sexes could be described by the same curve. Hence, differences in body shape did not account for differences in the selectivity of these species. In contrast, the taper for gravid female perch was markedly different from that for nongravid, as might be expected. Catches in which the positions where caught were carefully identified showed that most of the fish were caught either on the opercle or near the position of maximum girth. That the fish could be caught at different positions accounted for most of the skew in the selectivity curves based on maximum girth. Selectivity curves plotted on the basis of girth where caught, rather than on maximum girth or length, show that efficiency of capture was maximal when the girth of the fish was 1.0-1.2 times as great as the perimeter of the mesh. Efficiency was negligible at girth/perimeter ratios smaller than 0.8 or 0.9 and it declined rapidly at ratios greater than 1.2. However, a few fish were taken at ratios up to 1.5 or 1.6. (Authors)

11983. Halliday, R. G., and W. B. Scott. (Fisheries Res. Bd. of Canada, Biological Station, St. Andrews, New Brunswick, Canada). 1969. RECORDS OF MESOPELAGIC AND OTHER FISHES FROM THE CANADIAN ATLANTIC WITH NOTES ON THEIR DISTRIBUTION. J. Fish. Res. Bd. Canada, 26(10): 2691-2702.

The following 35 species are recorded from the Canadian Atlantic: Bathylagus euryops, Cyclothone spp., Maurolicus muelleri, Argyropelecus lychnus lychnus, Chauliodus sloani, Stomias boa ferox, Chlorophthalmus agassizi, Benthosema glaciale, Ceratoscopelus maderensis, Diaphus dumerili, D. termophilus, Hierops arctica, Hygophum hygomi, H. macrochir, Lampanyctus alatus, L. festivus, L. pusillus, Lobianchia dofleini, Myctophum punctatum, Notolychnus valdiviae, Notoscopelus krøyeri, N. resplendens, Symbolophorus veranyi, Notolepis rissoi krøyeri, Nemichthys scolopaceus, Nessorhamphus ingolfianus, Polymixia lowei, Trachurus trachurus, Decapterus macarellus, Stenotomus chrysops, Lycodes esmarki, Centrolophus niger, Psenes maculatus, Helicolenus dactylopterus, and Icelus bicornis. The composition of the mesopelagic fauna of the Slope Water region and the vertical migrations of its components are discussed. (Authors)

11984. Kume, Susumu, and James Joseph. 1969. SIZE COMPOSITION AND SEXUAL MATURITY OF BILLFISH CAUGHT BY THE JAPANESE LONGLINE FISHERY IN THE PACIFIC OCEAN EAST OF 130°W. Far Seas Fisheries Research Laboratory, Bulletin 2, pp. 115-162.

In this study we present information on size composition and sexual maturity collected from billfish captured by longline east of 130°W during the period 1963-1967. On the basis of these studies, some inferences are drawn concerning the population structure of the billfish inhabiting the eastern Pacific.

11985. Tautz, Arthur, P. A. Larkin, and W. E. Ricker (Inst. of Fisheries and Dept. of Zoology, The Univ. of British Columbia, Vancouver 8, B. C., Canada). 1969. SOME EFFECTS OF SIMULATED LONG-TERM ENVIRONMENTAL FLUCTUATIONS ON MAXIMUM SUSTAINED YIELD. J. Fish. Res. Bd. Canada, 26(10): 2715-2726.

For a variety of stock recruit systems, in which environmental variability is simulated by random normal deviates used as multipliers or divisors, Ricker, and Larkin and Ricker demonstrated the benefits of complete stabilization of escapement as opposed to removal of a fixed proportion of the stock each year. The present paper is primarily concerned with the response of these same systems to a pattern of stochastic modification that is more regular in form, a pattern such as might be imagined to result from long-term trends in environmental conditions. The simulations indicate that the gains derived from complete stabilization of escapement are determined solely by the variance of the modifiers – thus the pattern of modification, i.e., long- or short-term, is relevant only in terms of its influence on the variance. In addition, a check for maximum equilibrium catch using catch statistics is described. (Authors)

11986. Mathisen, Ole A. (Fisheries Research Institute, Univ. of Washington, Seattle, Washington). 1969. ALLOCATION OF WEIGHT AND LENGTH MEASUREMENTS FOR ESTIMATION OF THE AVERAGE WEIGHT OF JUVENILE SOCKEYE SALMON. J. Fish. Res. Bd. Canada, 26(10): 2741-2746.

The regression of weight on length of juvenile sockeye salmon was utilized to determine the optimal division of weight and length measurements in order to obtain minimum variance of the average weight estimate with a fixed expenditure of time to observations. (Auth.)

11987. Colton, John B., Jr. (Bur. of Comm. Fisheries, Biological Lab., Woods Hole, Massachusetts). 1969. TEMPERATURE CONDITIONS IN THE GULF OF MAINE AND ADJACENT WATERS DURING 1968. J. Fish. Res. Bd. Canada, 26(10): 2746-2751.

Surface-water temperatures at Boothbay Harbor, Maine, in 1968 were appreciably higher than in 1967. This check in the recent coastal cooling trend was reflected in offshore surface and subsurface temperature conditions and was accompanied by a shift in the relative position of Coastal and Slope Water along the edge of the Continental Shelf. (Auth.)

11988. Narver, David W. (Fisheries Res. Bd. of Canada, Biological Station, Nanaimo, B. C., Canada). 1969. AGE AND SIZE OF STEELHEAD TROUT IN THE BABINE RIVER, BRITISH COLUMBIA. J. Fish. Res. Bd. Canada, 26(10): 2754-2760.

Scales were collected from adult summer steelhead trout taken in 1967 and 1968 in an increasingly important sport fishery on the Babine River. The most common total age was 3.2 (73% in 1967 and 60% in 1968), and the second most common age was 3.3. The males tended to remain a year longer in the ocean than did females before first maturation. Four of 121 (3.3%) scales, all from female steelhead, indicated the fish had spawned once previously. The male to female ratio in the sport fishery was 1:1.33. Mean length at time of smolt outmigration as estimated from scales from 3.2 fish was 190 mm. These results are compared with what is known for other British Columbia steelhead stocks. (Auth.)

11989. Mighell, James L. (Bur. of Comm. Fisheries, Biological Lab., Seattle, Washington). 1969. RAPID COLD-BRANDING OF SALMON AND TROUT WITH LIQUID NITROGEN. J. Fish. Res. Bd. Canada, 26(10): 2765-2769.

Liquid nitrogen (at -196C) was successfully used as a coolant in a simple, inexpensive, and rapid method of marking salmon and trout with a metal branding tool. The marks, applied to as many as 650 fish per hour per marker, were consistently clear and readily identifiable for at least 14 months after application. No mortalities could be attributed to the branding technique among 4000 yearling coho salmon held for 2 months after marking. (Auth.)

11990. Kanid'yev, A. N. (Sakhalin Div., Pacific Research Inst. of Fisheries and Oceanography). 1969. SOME HEMATOLOGICAL FEATURES IN THE YOUNG OF THE SIBERIAN SALMON (Oncorhynchus keta Infrasp. autumnalis Berg) AND THEIR IMPORTANCE FOR ASSESSMENT OF THE QUALITY OF THE YOUNG AND REARING CONDITIONS. Problems of Ichthyology (Voprosy Ikhtiologii), American Fisheries Society, 9(2): 289-292.

Certain differences in the blood have been observed in the young of the Siberian salmon, growing in nurseries, ponds, and natural spawning grounds. The blood of the young salmon which were not given food contained fewer red cells than the blood of young from natural spawning grounds. Red cell counts increased with increasing age in young on intensive artificial feeding and in those reared in near-natural conditions. Hemoglobin contents were higher in young salmon feeding on natural foods than in those receiving artificial foods. This point must receive consideration in intensive rearing if the young are to be as physiologically complete as possible.

11991. Malyukina, G. A., and V. V. Konchin (Dept. of Animal Physiology and Dept. of Ichthyology, Moscow University, USSR). 1969. DEVELOPMENT OF GROUP EFFECTS DURING ONTOGENETIC DEVELOPMENT OF THE BALTIC SALMON AND THE SEVAN TROUT. Problems of Ichthyology (Voprosy Ikhtiologii), American Fisheries Society, 9(2): 292-297.

An adequate content of oxygen in the water is one of the most important requirements for the normal existence of aquatic animals; if it falls below a certain level, the organisms die. The reaction which has developed in herd forms in the course of evolution, whereby oxygen consumption in groups is reduced (group effect), is adaptational in nature; it promotes survival of the individual and preservation of the species. Experiments with the eggs of the Sevan trout and the Baltic salmon have shown that the group effect can be observed a few days after fertilization of the ovum and that it persists through all stages of embryonic development. After hatching out of the embryos, the group effect continued to be very much in evidence throughout all the experiments. In the period of embryonic development, when organs and functions are still in process of formation, control of the rate of respiration must apparently be achieved by chemical interaction between eggs, with metabolic products discharged by the eggs modifying the rate of oxygen consumption. The same mechanism may possibly function in the period immediately after hatching. Subsequently, as the organism develops greater complexity, the sensory systems, the animal's channels of communication with its environment, become differentiated; there is development of vision, of tactile, olfactory, lateral line, and taste organs. Experiments with Baltic salmon larvae, which were able to see, indicated that visual contact alone between the isolated individual and the group never reduced the individual's oxygen consumption to the level of the larvae in the group. These observations, together with the results of the experiments in which group effects were constantly seen with larvae in the dark, indicate that vision does not play a decisive role in the production of group behavior at these stages in the development of fishes. It is suggested that other systems, such as tactile, chemical and lateral line receptors, are responsible for contact between individuals in these stages.

11992. Lapin, Yu. Ye. (Inst. of Evolutional Animal Morphology and Ecology, USSR Academy of Sciences, Moscow, USSR). 1969. NUMERICAL RELATIONSHIPS BETWEEN YEAR CLASSES AND PARENT STOCKS OF FISHES AND THE EFFECTS OF COMMERCIAL FISHING ON STOCK REPRODUCTION. Problems of Ichthyology, (Voprosy Ikhtiologii), American Fisheries Society, 9(2): 187-196.

The characteristic features of reproduction in fishes are high fecundities and high and variable mortalities. The numerous unfavorable factors to which the progeny are exposed and the uncertainty of survival are responsible for the uncertain nature of the connection between the quantity of spawn deposited and the number of the progeny that result from it. When conditions for the survival of the offspring are relatively stable, the parent/progeny relationship tends to be more linear, and this is illustrated by the Far Eastern salmon, Oncorhynchus nerka, which actively looks after its posterity.

11993. Kuz'min, A. N. (State Scientific Research Inst. of Lake and River Fisheries (GosNIORKh), Leningrad, USSR). 1969. DEVELOPMENT OF THE REPRODUCTIVE SYSTEM IN FEMALE BROAD WHITEFISH [Coregonus nasus (Pallas)], REARED IN PONDS AND LAKES OF NORTHWEST USSR. Problems of Ichthyology (Voprosy Ikhtiologii), American Fisheries Society, 9(2): 197-204.

A histological study has been made of gametogenesis, sexual maturation, and disturbances of oogenesis in females reared under a variety of ecological conditions. It has been shown that the growth of females in ponds, though successful, is associated with resorption and fatty degeneration of a proportion of oocytes in the stage of trophoplasmic growth. When the whitefish were reared in waters in which there was no flow (lakes), there was, in females, in addition to resorption of oocytes in the trophoplasmic stage of growth, considerable retardation in the development of the gonads in the period of cytoplasmic growth of oocytes. The main factors concerned in the disturbed development of the reproductive system in the whitefish are the hydrological conditions prevailing in ponds and lakes, as these do not conform to the biological requirements of the species.

11994. Bergel'son, B. O., and Yu. I. Nikanorov (Ostashkov Branch of the State Scientific Research Inst. of Lake and River Fisheries (Gos NIORKh), USSR). 1969. SEX MATURATION AND SPAWNING OF THE PELED [Coregonus peled (Gmelin)] IN LAKE LOKHOVO (KALININ DISTRICT). Problems of Ichthyology (Voprosy Ikhtiologii), American Fisheries Society, 9(2): 210-217.

The results of the introduction of peled spawn and larvae into L. Lokhovo are discussed. The lake was given preliminary chemical treatment with polychlorpinene. Several successive lots of eggs and larvae were introduced in 1964 and 1965. Satisfactory increases in size and weight were noted in the first years. Points discussed include the characteristics of the lake, the growth and nutritional state of the peled, age of attainment of sexual maturity, spawning effectiveness indices, and commercial return.

11995. Rukhlov, F. N. (Sakhalin Dept. for the Conservation and Propagation of Fish Stocks and the Control of Fishing - Sakhalinrybvod, Yuzhno-Sakhalinsk, USSR). 1969. THE NATURAL REPRODUCTION OF THE AUTUMN CHUM SALMON [Oncorhynchus keta (Walb.)] ON SAKHALIN. Problems of Ichthyology (Voprosy Ikhtiologii), American Fisheries Society, 9(2): 217-223.

The main features of the river stage in the life of Oncorhynchus keta on Sakhalin are described, viz; the migrations of the spawners to the spawning-grounds, size and weight values, fecundity, spawning, embryonic and larval development, and the seaward migrations of the fry from the natural spawning grounds. The larger individuals among the first fish to arrive generally spawn in the upper reaches of the rivers. A certain tendency is demonstrated towards a reduction in the size/weight composition and the fecundity of the spawning population with decreasing river-length.

11996. Pavlov, D. S. (Inst. of Evolutionary Morphology and Ecology of Animals, USSR Academy of Sciences, Moscow, USSR). 1969. ENTRAPMENT OF FISH FINGERLINGS IN PUMPING INSTALLATIONS AS RELATED TO FEATURES OF THEIR BEHAVIOR AND ORIENTATION IN THE STREAM OF WATER. Problems of Ichthyology (Voprosy Ikhtiologii), American Fisheries Society, 9(2): 237-243.

The principal cause of the entrapment of fingerlings of teleostean fishes in water-intake structures is the loss of visual orientation in the stream of water. In this connection, in open-water reservoirs with water transparency exceeding 30 cm (according to the Secchi disk) 70-90% of the fingerlings are entrained into these structures at twilight and night. To protect the fingerlings the intake of water for irrigation must be restricted at twilight and night. If this is not possible, then, along with other measures, illumination at twilight and night should be employed as an effective means for protection of the fingerlings.

11997. Il'yenko, A. I. (A. N. Severtsov Inst. of Evolutionary Morphology and Ecology of Animals, USSR Academy of Sciences, Moscow, USSR). 1969. RADIOECOLOGY OF FRESHWATER FISHES. Problems of Ichthyology (Voprosy Ikhtiologii), American Fisheries Society, 9(2): 249-260.

The author presents a review of present-day literature on the patterns of the build-up (concentration and elimination) of various radionuclides in fish, their distribution in the body and the biological effect of ionizing radiation and build-up of radioactive isotopes on these animals. Special attention is devoted to the ecological features of various fish species and certain environmental effects of habitat (temperature and chemical composition of water) which affect the differences in the concentration of radionuclides.

11998. Hourston, A. S. 1970. COMPUTER PROGRAMS FOR PROCESSING NEWFOUNDLAND HERRING DATA. Fish. Res. Bd. Canada Technical Report No. 166, manuscript information, 143 p.

During the fall of 1968 and the spring of 1969, 23 computer programs were written and 10 existing programs adapted for the analysis of herring sampling, catch and fishing effort data collected in Newfoundland during the 1964-65 to 1967-68 fishing seasons. These programs were written in Fortran 1130, a subset of Fortran IV, for processing on the 16K single disk IBM-1130 computing system at the Nanaimo Station under version 2 disk monitor. In addition to the CPU with its associated disk capacity, a 1442 card read punch, an 1132 printer, and a 1627 model 2 plotter included in the system were employed in processing the data. Processing of the data was carried out in six stages, as follows, each involving a group of several programs. I. Tabulation and summarization of sampling data (9 programs). II. Tabulation of catch in tons and conversion to thousands of fish (5 programs). III. Tabulation of catch and effort and calculation of catch (thousands of fish) per unit of effort (days fishing and/or number of sets) which may be adjusted for differences in boat efficiency (4 programs). IV. Calculation of recruitment rates from age composition (5 programs). V. Estimation of abundance (6 programs). VI. Miscellaneous operations which test for significant differences in vertebral number between groups, plot age (or maturity) distributions, calculate fecundity and calculate the percent composition for various groupings of maturity stages (4 programs). (From auth. introduction)

11999. Takita, Toru, Shiro Fujita, and Yoshie Dotsu (Faculty of Fisheries, Nagasaki Univ., Nagasaki, Japan). 1967. EGG DEVELOPMENT AND PROLARVAL STAGES OF THE FLATFISH Verasper variegatus (Temminck et Schlegel). Bull. Fac. Fish. Nagasaki No. 23, pp. 101-106.

Verasper variegatus (Temminck et Schlegel) is a common flatfish in Japan and mainly distributed along the coast of Southern Japan. On January 18 and 22, 1966, artificial inseminations of this fish were carried out on the coast of Aba in Nagasaki City, and the egg development and hatched larvae were observed. This fish seems to spawn in January and February in the coastal waters of Western Kyushu and the adjacent area. The matured female has a pair of large ovaries, but, the matured male has small testes with seminal vesicles. The fertilized egg is buoyant, colorless and spherical in shape, measuring 1.60-1.64 mm in diameter. The egg has no oil globule, and its perivitelline space is very narrow. The fundamental process of early egg development was much the same as that of other teleostean eggs which have been reported. The melanophores first appeared on the embryo and yolk sac about 60 hours after insemination, and with the development of the egg, they gradually became thicker on the back of the embryo and the yolk sac. The hatching took place 107 hours after insemination at a water-temperature of 12°-13°C. The newly hatched larva, measuring about 3.80 mm in total length, had 13 + 29 = 42 myomeres (This fish has 41-42 vertebrae). The anus is open at about the mid point of the body. The larval fin fold has a pattern with a great number of small globules and lines which connect the globules to one another. The melanophores and the xanthophores are thickly scattered on almost the whole larval body and yolk sac, and some of them extend to the fin fold at the mid part of the tail. The 5-day-old larva was 5.18 mm in total length. In this larva the eyes were black and the mouth was open. (Authors)

12000. Hunn, Joseph B., and Wayne A. Willford (Bur. of Sport Fisheries and Wildlife, Fish Control Lab., LaCrosse, Wisconsin). 1970. THE EFFECT OF ANESTHETIZATION AND URINARY BLADDER CATHETERIZATION ON RENAL FUNCTION OF RAINBOW TROUT. Comp. Biochem. Physiol., 33(4): 805-812.

Rainbow trout were anesthetized with MS-222 (Sandoz) or methylpentynol and catheterized. Urine was collected at selected intervals up to 48 hr. Effects of MS-222 anesthesia on urine flow and composition were isolated from the stress of catheterization by re-anesthetizing the fish 18 to 20 hr post-catheterization. Urine output patterns were similar following MS-222 or methylpentynol anesthesia and catheterization. Highest urine flows were measured 4 to 8 hr post-treatment. The highest urine output after re-anesthetization with MS-222 was observed 2 to 4 hr post-anesthesia. Highest concentrations of Na^+, K^+, Ca^{2+}, Cl^- and inorganic PO_4 in the urine were measured in the first 2 hr after anesthesia and catheterization. Flow rates and chemical composition of urine indicate that "normal" renal function is re-established 12 to 24 hr post-treatment. (Authors)

12001. McNulty, J. Kneeland (U. S. Dept. of the Interior). 1970. EFFECTS OF ABATEMENT OF DOMESTIC SEWAGE POLLUTION ON THE BENTHOS, VOLUMES OF ZOOPLANKTON, AND THE FOULING ORGANISMS OF BISCAYNE BAY, FLORIDA. Marine Science Publications, University of Miami Press, Drawer 9088, Coral Gables, Florida 33124, 128 pp., cloth, $6.95.

Various elements of the biota of northern Biscayne Bay, Florida, were studied before and after abatement of pollution consisting of 136 to 227 million liters per day of untreated domestic sewage. Four years after removal of pollution a number of changes had taken place; these are interpreted to mean that long-lasting detrimental effects have resulted from pollution and dredging.

12002. Umemoto, Shigeru, and Koichi Kanna (Tokai Reg. Fish. Res. Lab., Kachidoki, Chuoku, Tokyo, Japan). 1969. STUDIES ON GEL FILTRATION OF FISH MUSCLE PROTEIN -- II. GEL FILTRATION OF SARCOPLASMIC AND MYOFIBRILLAR PROTEINS ON SEPHAROSE 2B. Bull. Jap. Soc. sci. Fish. 35(6): 555-558 (In Japanese; summary, figures, and table in English); Commercial Fisheries Abstracts, December 1969, 22(12): Abstract 7.51.

In 1968, the authors reported that several peaks of eluted proteins had been seen in the elution diagrams of fish muscle protein that had been subjected to gel filtration on agarose gels. To interpret these elution profiles, they submitted sarcoplasmic protein and actomyosin prepared from fish muscle and myosin prepared from both fish and rabbit muscle to gel filtration on Sepharose 2B. In the resulting elution patterns, they observed peaks of major component protein at each definite elution volume. The K_{av} values were 0.9 to 1.0, 0.4 to 0.5, and 0.0 to 0.1 for sarcoplasmic protein, myosin, and actomyosin, respectively. From these results, the authors conclude that fish muscle protein can be fractionated into three kinds of proteins--sarcoplasmic protein, myosin, and actomyosin (and/or aggregated protein)--by gel filtration on Sepharose 2B. -- L. Baldwin

12003. Elson, K. G. R. (Dept. of Agriculture and Fisheries for Scotland, Marine Lab., P.O. Box 101, Torry, Aberdeen, Scotland). 1969. WHIRLING DISEASE IN TROUT. Nature 223, No. 5209, 968; Commercial Fisheries Abstracts, December 1969, 22(12): Abstract 9.15.

Whirling disease, a serious problem in the intensive rearing of salmonid fish in Europe, was found in Scotland in October 1968. The etiological agent of the disease, the myxosporidian protozoan parasite Myxosoma cerebralis was identified in rainbow trout (Salmo gairdneri) from two trout farms. The causative parasite had not been identified previously in Great Britain. The author postulates that the disease may have already existed in wild populations before the present diagnosis, but it is also possible that the spores of M. cerebralis may have been introduced into Scotland via egg packing materials. -- F. T. Piskur

12004. Mano, Yoshitake, and Mihoko Yoshida (Dept. of Biochemistry, Faculty of Medicine, Univ. of Tokyo, Bunkyo-ku, Tokyo, Japan). 1969. A NOVEL COMPOSITION OF PHOSVITINS FROM SALMON AND TROUT ROE. J. Biochem. 66, No. 1, 105-108; Commercial Fisheries Abstracts, December 1969, 22(12): Abstract 8.51.

In 1966, Mano and Lipmann found that the phosvitins from a variety of fish roes had a similar amino-acid composition but differed in detail according to fish species. The basic amino-acid composition was characterized by the predominance of serine and the modicum of certain other amino acids. Sulfur-containing and aromatic amino acids especially were lacking. However, the lack of aromatic amino acids was not universal. In the present paper, the authors report their findings about the composition of phosvitins from the roe of dog salmon (Oncorhynchus keta) and rainbow trout (Salmo irideus), and they describe the method by which they obtained their results. (This preparative method, they say, is applicable to all kinds of fish roe but not to other tissues or to hen eggs. Its yield is almost quantitative.) The phosvitins obtained from the fractions having the highest phosphorus content were homogeneous in chromatograms and schlieren patterns. The data show the similarity of salmon and trout phosvitins. Further, both salmon- and trout-roe phosvitins had the following moles of amino acid per molucule: lysine, 5; histidine, cysteine, valine, methionine, leucine, phenylalanine, tryptophan, 0; glutamic acid, proline, glycine, 4; alanine, 3; and tyrosine, 1. Both contained 2 moles of glucosamine per molecule; neither showed signs of uronic acid. The authors conclude that the amino-acid composition and the other properties of the phosvitins from these related fishes show minimal species differences.

12005. Stark, Ake (Inst. of Analytical Chemistry, Univ. of Stockholm, Stockholm, Sweden). 1969. ANALYSIS OF PENTACHLOROPHENOL RESIDUES IN SOIL, WATER, AND FISH. J. agric. Fd Chem. 17(4): 871-873; Commercial Fisheries Abstracts, December 1969, 22(12): Abstract 7.9.

This paper presents a simple method, adapted for gas chromatographic determinations, for the extraction of pentachlorophenol (PCP) in soil, water, and fish. PCP can be detected down to 0.5 p.p.b. in soil or fish and down to 0.01 p.p.b. in water. -- F. T. Piskur

12006. Learson, Robert J. (Technological Lab., U. S. Fish & Wildl. Service, Bur. of Comm. Fisheries, Gloucester, Massachusetts). 1969. COLLABORATIVE STUDY OF A RAPID ELECTROPHORETIC METHOD FOR FISH SPECIES IDENTIFICATION. J. Assn. Official Analytical Chemists, 52(4): 703-707; Commercial Fisheries Abstracts, December 1969, 22(12): Abstract 7.9 (7.86).

The purpose was to study, collaboratively, a proposed rapid electrophoretic method (using cellulose acetate as the supporting medium) for identifying species of fish. In this test the authentic fish samples were replaced with photographs of standard protein patterns from authentic species of fish. Six "unknown" samples of fish were sent to 12 collaborators. The analysts, using the proposed electrophoretic method, were to identify the various species from the set of photographs representing standard protein patterns from nine species of fish. Ten collaborators reported (two did not report) that correct identification of the "unknown" species from the photographic standards was extremely difficult. The analysts were able to match duplicate samples with an accuracy of 90 percent, but were able to correctly identify only 39 percent of the unknown samples. The author suggests that authentic samples are required for positive identification and that the method be subjected to further collaborative study using authentic fish samples for standards. -- F. T. Piskur

12007. Cunningham, B. T. (Fisheries Div., Marine Dept., Wellington, New Zealand). 1969. FISHERIES DIVISION INVESTIGATIONS PROGRESS REPORT - 1968. New Zealand Marine Dept. Fisheries Technical Report No. 41, 30 p.

Includes: investigations on Mollusca, Crustacea, wetfish, fish technology, gear technology, and sport fisheries. The sport fishery investigations consist of: Tongariro power scheme, Northland Lakes, WHEAO power scheme, Upper Waitaki power scheme, Te Anau - Manapouri scheme, Lake Coleridge investigation, Quinnat salmon age studies, fast growing Quinnat salmon, South Branch studies, electric fishing, technical field service, Aviemore Spawning Race, angling diary scheme.

12008. Mounib, M. S., and J. S. Eisan (Fisheries Res. Bd. of Canada, Halifax Lab., Halifax, Nova Scotia, Canada). 1969. METABOLISM OF PYRUVATE AND GLYOXYLATE BY EGGS OF SALMON (Salmo salar). Comp. Biochem. Physiol. 29(1): 259-264 (Pergamon Press, New York, N. Y.); Commercial Fisheries Abstracts, December 1969, 22(12): Abstract 9:13.

Mounib (1967) showed that when sperm of cod (Gadus morhua) or salmon (Salmo salar) are incubated with pyruvate, at least three reactions take place: (1) reduction to lactate, (2) oxidative decarboxylation of pyruvate, and (3) fixation of CO_2 with pyruvate. Mounib and Eisan (1966 and 1968) demonstrated that salmon sperm are able to incorporate pyruvate, acetate, and glyoxylate into their lipids. The purpose of the present study was to examine the metabolism in salmon eggs of pyruvate and glyoxylate labeled with ^{14}C in different positions. The results indicated that salmon eggs were able to fix carbon dioxide with pyruvate and that they metabolized glyoxylate via the glycerate pathway. The formation of ^{14}C-amino acids from the ^{14}C-pyruvate and ^{14}C-glyoxylate indicated the presence of an active transaminase system in salmon eggs. -- F. T. Piskur

12009. Gakstatter, J. H. 1967. UPTAKE FROM WATER BY SEVERAL SPECIES OF FRESH WATER FISH OF p, p'-DDT, DIELDRIN AND LINDANE; THEIR TISSUE DISTRIBUTION AND ELIMINATION RATE. Diss. Abstr., B. 27, 3820 (1967); J. of the Science of Food and Agriculture 20(6): i-437 (June 1969); Commercial Fisheries Abstracts, December 1969, 22(12): Abstract 9. 15 (9. 19).

DDT, dieldrin, and lindane, all ^{14}C-labeled insecticides, were added in sublethal concentrations to water into which four species of fish (1 gram of fish per liter of water) had been placed. After recovery periods of up to 41 days, the rate at which the insecticides had been taken up from the water was determined by analysis of residues in the various fish tissues: DDT > dieldrin > lindane. The insecticides were distributed in various proportions among all the tissues, but concentration was greatest in visceral fat; it was least in muscles. High concentrations in the liver, gallbladder, pyloric ceca, and intestines were attributed to these organs' being in the route of excretion. Rates of excretion during recovery varied -- more than 90 percent of the lindane was eliminated after 2 days and more than 90 percent of the dieldrin after 16 days, but about 50 percent of the DDT was still present after 32 days. All the insecticides were readily transferred from the contaminated fish to uncontaminated fish newly introduced to the recovery water. -- L. Baldwin

12010. Ishihara, Tadashi, Masato Yasuda, and Osamu Tamura. 1967. EFFECT OF PESTICIDES ON BLOOD CHARACTERS AND OXYGEN CONSUMPTION OF CARP. Bull. Fac. Fish. Nagasaki No. 24, 65-78. (In Japanese with Engl. Abstract).

Through use of four kinds of pesticides, namely PCP (effective ingredient: Penta chlorophenol 86%), MEP (e.i.: Dimethyl thiophosphate 50%), Endrin (e.i.: Endrin 19. 5%) and Meran (e.i.: Phenylmercuric acetate and other organic mercury 5. 2%), a study was made on the effect of these pesticides on the blood characters and oxygen consumption of carp which were kept for three days in water containing each of these pesticides. The effect on blood characters was studied by means of observation of change in specific gravity, hematocrit value, serum protein and serum lipoprotein. Feeding was sustained during the three-day period of the experiments. Blood sampling was made from each individual carp prior to and on the third day after the application of pesticides to the water. Each pesticide caused change in the component ratio of serum protein and serum lipoprotein and the change was more pronounced in the former. Both specific gravity and hematocrit value decreased in comparison with the values at the first sampling. However, in consideration of the noticeable effect of sampling, these showed a trend of increase in proportion to the density of pesticide. In connection with oxygen consumption, PCP caused an increase in proportion to its density. However, MEP caused a decrease and the extent of decrease was proportional to the density. Endrin and Meran also caused a decrease but the extent of decrease was inversely proportional to the density. (Authors)

12011. Tamura, Osamu, Seiro Shiozaki, Kiyoshi Fujiwara, and Hiroshi Hirashima. 1967. THE FUNDAMENTAL EXPERIMENTS ON THE TRANSPORT OF LIVE FISH – I. THE EFFECTS OF THE ANESTHETICS AND THE FALL OF TEMPERATURE ON THE OXYGEN CONSUMPTION OF FISH. Bull. Fac. Fish. Nagasaki No. 22, pp. 57-67.

Tests were performed for the effects of several kinds of anesthetics and reduction of temperature on the oxygen consumption of carp, goldfish and others. The duration of the anesthesia of fish by tertiary amyl-alcohol was relatively longer than by the other anesthetic reagents tested. By using a dilute solution of anesthetic, the volume of water in the transport of live fish can be reduced considerably. For the purpose of reducing water in the transport of live fish, MS222, tertiary amyl-alcohol, paraldehyde and quinaldine are very effective, and the last three reagents are recommended from the economical standpoint. The oxygen consumption of carp can be reduced to less than 40 percent by the joint use of anesthetics and reduction of temperature by 14°C. (Authors)

12012. Reed, John K. (Clemson Univ., South Carolina). 1969. INTERACTION OF PESTICIDE POLLUTANTS AND AQUATIC FOOD-CHAIN ORGANISMS. Water Resources Research Institute, Technical Completion Report, 18 p., available from the Clearinghouse as PB-188 794, $3.00 paper copy, $0.65 in microfiche; Selected Water Resources Abstracts, 3(7), 1970, p. 34.

Small golden shiner minnows, Notemigonus crysoleucas, were exposed to a constant level of DDT either in water or in food. The DDT was ring labelled with carbon-14 and was assayed in a liquid scintillation system and by gas-liquid chromatography. Over a 15-day period the mean aqueous DDT concentration was 265 parts per trillion which resulted in a level of 180 ppb absorbed to the outside of the fish and 22.530 ppb absorbed internally. This represented nearly a 100,000 fold accumulation of DDT in fish from flowing water. When fish were fed contaminated food, no DDT was found absorbed externally on the fish or in the water. In both cases the level in the fish increased with time.

12013. Cole, Charles F. (Massachusetts Univ., Amherst, Water Resources Research Center, Amherst, Massachusetts). 1969. THE ECOLOGY OF THE YOUNG FISHES OF THE WEWEANTIC RIVER ESTUARY. Massachusetts Water Resources Research Center, Completion Report 69-1, 15 p., available from the Clearinghouse as PB-188 795, $3.00 paper copy, $0.65 in microfiche; Selected Water Resources Abstracts, 3(7), 1970, p. 34.

The Weweantic River estuary in upper Buzzards Bay, Massachusetts was selected in 1964 for a long-term study of estuarine fishes and the factors that control their levels of abundance. Seven master's and two doctoral studies have been conducted during this period on the seasonality of fish eggs, larvae, juveniles and adults and on the life histories of the tomcod, rainbow smelt, cunner, tautog, and winter flounder. Additional studies on the seasonal distribution of certain physical and chemical parameters and studies on the historical use of the watershed since colonial times were carried out. Pesticide residue levels and their possible effects in winter flounder have also been investigated. Methods for quantifying ichthyoplankton sampling for in-situ mortality studies of winter flounder and rainbow smelt have also been evaluated. Between-year variation in the natural environmental parameters is a strong factor regulating size of year class in at least the tomcod, rainbow smelt and winter flounder. The study of man-caused environmental modifications on populations of estuarine fishes must take into consideration the scope and nature of these naturally caused variations in population size and structure.

12014. Whitworth, Walter R. (Connecticut Univ., Storrs, Connecticut). 1969. EFFECTS OF SIMULTANEOUS VARIATION OF TEMPERATURE AND DISSOLVED OXYGEN ON THE RESISTANCE OF FISHES TO CONTROLLED POLLUTANTS. Research Project Technical Completion Report, 2 p.; Selected Water Resources Abstracts, 3(7), 1970, p. 35.

Slug doses of lead administered once a day 5 days/week to brook trout exposed

to simultaneous diel fluctuations of dissolved oxygen and temperature showed that concentrations of 25 mg/liter of lead reduced growth. Concentrations of 15 mg/liter had little apparent effect and concentrations of 10 mg/liter had no deleterious effects on growth. Lead levels that were effective had a greater effect (1) when oxygen fluctuated on a diel basis to 2.4 and 3.5, and (2) when temperatures fluctuated from 10.0-16.0. Short-term toxic effects of lead on brook trout, bridled shiners, blacknose dace and banded killifish at temperatures of 10-21 C, showed (96 hr. EC50) from 4 to 40 mg/liter. Oxygen consumption of bridled shiners was not significantly affected by exposures to 2 and 8 mg/liter of lead. Lead levels of approximated 15 mg/liter had no significant effects on the eggs of brook trout and American shad.

12015. Shentyakova, L. F. (Institute of the Biology of Inland Waters, USSR Academy of Sciences, USSR). 1969. THE VERIFICATION BY MATHEMATICAL TESTS OF THE HYPOTHESIS THAT THE RELATIONSHIP BETWEEN BODY GROWTH AND THE SCALES OF FISHES IS CONSTANT WITHIN THE SPECIES. Problems of Ichthyology (Voprosy Ikhtiologii), American Fisheries Society, 9(3): 338-354.

The existing methods of establishing the growth of fishes from the scales are evaluated. Taking an estimation of the form of the correlation as a test, it is established that the correlation between body growth and the scales of fishes is curvilinear in the overwhelming majority of instances. The hypothesis that there are features specific to populations in the relationship between the growth of the scales and the body of fishes is verified by tests: the discrepancies of the experimental curves, the Pearson criterion and the Bartlett test; the comparison was made for the main food fishes of the Volga River basin. Confirmation was obtained for the hypothesis that the character investigated differs under different conditions of existence. Chebyshev's method was used to calculate formulas reflecting the relationship between the growth of the scales and the body of the fishes in different bodies of water and in local and intra-population groups. The Pearson criterion was used to confirm the significance of the similarity between the observed data and the data calculated by Chebyshev's method.

12016. Gorbunova, N. N. (Institute of Oceanology, USSR Academy of Sciences, Moscow, USSR). 1969. BREEDING GROUNDS AND FOOD OF THE LARVAE OF THE SWORDFISH [Xiphias gladius Linne (Pisces, Xiphiidae)]. Problems of Ichthyology (Voprosy Ikhtiologii), American Fisheries Society, 9(3): 375-387.

Use is made in the paper of collections of swordfish larvae and young made on several cruises of the Vityaz' in the Pacific and Indian Oceans. The frequency of occurrence of the larvae increases perceptibly in the northwestern area of the Atlantic Ocean, in the eastern portion of the Indian Ocean and in the area of the island of Madagascar, in the western waters of the Pacific Ocean (the Kuroshio area) and the central waters. The spawning grounds are associated with areas of increased productivity due to the emergence of deep water at the surface. In the areas where zooplankton is plentiful conditions are created which are conducive to the feeding of many plankton-feeding larvae on which swordfish larvae and young feed. Great similarity is to be noted between the range of food items in different areas of the Atlantic, Indian and Pacific oceans. The larvae feed twice a day, coinciding with the diurnal distribution pattern of the food objects.

12017. Gritsenko, O. F. (All-Union Res. Inst. of Marine Fisheries and Oceanography (VNIRO, Moscow, USSR). 1969. DIET OF THE CHAR [Salvelinus alpinus (L.)] IN THE RIVERS OF SAKHALIN. Problems of Ichthyology, (Voprosy Ikhtiologii), American Fisheries Society, 9(3): 410-417.

Eggs and young of salmon of the genus Oncorhynchus constitute the basic food of the char, Salvelinus alpinus (L.), in the rivers of Sakhalin. The times and duration of feeding of the char are determined by the time of appearance of this food and its abundance, factors which differ substantially in the rivers of different types depending on the species of salmon involved and their spawning times. Salmon losses caused by char predation on the young stages are not great, since the char consumes mainly inviable eggs and weak young.

12018. Vasil'yeva, V. F., G. P. Gusev, Yu. V. Natochin, and Ye. I. Shakhmatova (Lab. on the Development of the Excretory Function, Sechenov Inst. of Evolutionary Physiology and Biochemistry, USSR Academy of Sciences, Leningrad, USSR). 1969. EXCRETION OF ELECTROLYTES BY THE KIDNEY OF THE HORSE MACKEREL [(Trachurus)] AND THE SEA SCORPION [(Scorpaena)] AFTER INJECTION OF Na, K, Ca OR Mg CHLORIDES. Problems of Ichthyology, (Voprosy Ikhtiologii), American Fisheries Society, 9(3): 434-442.

In order to study the ion-regulating function of the kidneys of marine teleost fishes (sea scorpion and horse mackerel), chloride salts of sodium, potassium, calcium or magnesium were injected intramuscularly. The injection of salts did not cause a significant increase in the concentration of the injected ions in the urine. The excretion of the injected cations did not change in the case of the horse mackerel, but the excretion of all ions increased in the sea scorpion as a result of an increase in the rate of glomerular filtration and diuresis. The data obtained indicate that the kidney of marine fishes can achieve only slow correction of disturbed ionic homeostasis.

12019. Smith, M. W. (Fisheries Res. Bd. of Canada, Biological Station, St. Andrews, N. B., Canada). 1969. CHANGES IN ENVIRONMENT AND BIOTA OF A NATURAL LAKE AFTER FERTILIZATION. J. Fish. Res. Bd. Canada 26(12): 3101-3132.

When artificial fertilizers were added to unstratified, soft-water Crecy Lake (20 ha), New Brunswick, in three years (1946, 1951, and 1959), the lake was sufficiently self-regulatory that the artificial enrichments had only a temporary effect on organic production. The induced eutrophication proved largely reversible, with minor evidence of hastened senescence of the lake over an 18-year period. Each fertilization provided 210 ppb (parts per billion) of nitrogen (N), 390 ppb of phosphorus (P), and 270 ppb of potassium (K) to the water if the fertilizers were equally distributed throughout the lake. The highest concentrations of total P, determined daily after the fertilizations in 1951 and 1959, were 220 ppb after 2 days and 192 ppb after 1 day, respectively. The concentration of inorganic P declined rapidly from about 150 ppb the day after the fertilizations in 1951 and 1959 to <10 ppb at a percentage loss per day of 5.5. Concentrations of organic P were highest 5 (80 ppb, 1951) and 8 (43 ppb, 1959) days after the fertilizations and declined to equilibration above prefertilization values for 3-4 months, and then to prefertilization values during the next years. Phosphorus lost in the drainage from the lake, assessed only in 1951 and 1959, was equivalent in these years to 8.5 and 12% of the amounts added in the fertilizers. Limited observations indicated an increase of nitrate N in the water immediately after fertilization, but then a rapid loss. Deficits in dissolved oxygen were greatest under ice in the winters immediately after algal blooms induced by the fertilizers, but were serious in only about 30% of the volume of the lake. Specific conductance of the water exhibited minor change with fertilization. Pronounced algal blooms, not previously recorded for the lake, followed each fertilization. Years of fertilization, and the next, were marked by blooms of Anabaena. Intensified growth of Spirogyra usually followed closely the blooms of Anabaena. In the 3rd year after fertilization algal growth was weak, at prefertilization densities. During blooms of Anabaena the numbers of zooplankters and bottom organisms, and growth of submerged, rooted aquatic vegetation, decreased. Zooplankton and bottom fauna were most abundant 2-4 years after fertilizations. Of the rotifers, three out of eight species became abundant. Of the planktonic microcrustaceans, Leptodiaptomus was always the most numerous; Diaphanosoma and Daphnia were more numerous after the last fertilization (1959) than they were earlier. Among the bottom organisms, Hyalella, chironomids, Amnicola, and spaeriids increased most in abundance after the fertilizations. (Auth.)

12020. Snieszko, S. F., F. T. Wright, Glen L. Hoffman, and Ken Wolf (Eastern Fish Disease Lab., Leetown, West Virginia). 1970. SELECTED FISH DISEASE PUBLICATIONS IN ENGLISH. U. S. Dept. of the Interior., Bur. of Sport Fisheries and Wildlife, Fish Disease Leaflet No. 26. (Formerly Fishery Leaflet 570 of June 1964.).

12021. Pinhorn, Allenby T. (Fisheries Res. Bd. of Canada, Biological Station, St. John's, Newfoundland, Canada). 1969. FISHERY AND BIOLOGY OF ATLANTIC COD (Gadus morhua) OFF THE SOUTHWEST COAST OF NEWFOUNDLAND. J. Fish. Res. Bd. Canada, 26(12): 3133-3164.

Data collected from the fishery off the southwest coast of Newfoundland indicated a decrease in the proportions of larger and older cod in ICNAF Division 3Pn in recent years. Changes in total mortality rates in 3Pn and on Burgeo Bank have been attributed to fluctuations in total landings and effort. Decreased growth rates for the younger cod and increased followed by decreased growth for the older cod were attributed to increased food supply superimposed on decreased bottom temperatures. Cod from Burgeo Bank grow faster than those from 3Pn. Sizes caught by various types of inshore boats were similar but larger fish were caught in deeper water, in eastern rather than western localities, and in the latter part of the season. Peak spawning occurs in May. Males were predominant in longline catches and matured at an earlier age and smaller size than females. Fish in the 3Pn area matured earlier and at a smaller size than Burgeo Bank fish. Vertebral averages at different localities in the area were similar but averages have decreased in recent years. Limited data on weights and fecundity are presented. Results are discussed in light of the separation of West Newfoundland and Burgeo Bank stocks. (Auth.)

12022. Seki, H., and Owen D. Kennedy (Fisheries Res. Bd. of Canada, Biological Station, Nanaimo, B. C., Canada). 1969. MARINE BACTERIA AND OTHER HETEROTROPHS AS FOOD FOR ZOOPLANKTON IN THE STRAIT OF GEORGIA DURING THE WINTER. J. Fish. Res. Bd. Canada, 26(12): 3165-3173.

Microbiological investigation was carried out in the waters of the Strait of Georgia during the winter to study the occurrence of heterotrophic microorganisms in relation to other particulate organic materials, including plankton and detritus. High microbial activity was measured in the euphotic zone, where marine bacteria and allied microorganisms were chiefly found on the particulate matter having diameter less than 25 μ. Their standing crop was estimated by different methods to be between 40 and 3000 mg C/m^2 and some of this was consumed by the zooplankton, which were found to have concentrated the bacteria by a factor of around 10^5. Only the highest levels of microbial production were estimated to be sufficient to support a subsistence level of life for marine copepods in the Strait of Georgia. (Authors)

12023. Buhler, Donald R., and P. Benville (Bur. of Sport Fisheries and Wildlife, Fish Pesticide Res. Lab., Columbia, Missouri). 1969. EFFECT OF FEEDING AND OF DDT ON THE ACTIVITY OF HEPATIC GLUCOSE 6-PHOSPHATE DEHYDROGENASE IN TWO SALMONIDS. J. Fish. Res. Bd. Canada, 26(12): 3209-3216.

The specific activity of liver glucose 6-phosphate dehydrogenase in yearling rainbow trout remained unchanged when the fish were starved for periods as long as 8 weeks and when starved animals were fed diets of various compositions. Injection of insulin concurrently with refeeding also failed to alter the specific activity of the enzyme in trout. The absence of a dietary or insulin influence on the teleost enzyme system is to be contrasted with studies in mammals in which the activity of hepatic glucose 6-P dehydrogenase was markedly stimulated after refeeding starved animals or injection of insulin. Ingestion of the pesticide DDT by juvenile coho salmon or adult rainbow trout also had no effect on the specific activity of liver glucose 6-P dehydrogenase and DDT failed to inhibit the rainbow trout enzyme in vitro. These results also differ considerably from those found in higher animals. These results suggest that the glucose 6-P dehydrogenase enzyme in teleosts may be under a different type of regulatory control from that found in mammals. (Authors)

12024. Bearden, Charles M. 1961. COMMON MARINE FISHES OF SOUTH CAROLINA. Contributions from Bears Bluff Laboratories No. 34, Wadmalaw Island, South Carolina, 47 p.

12025. Kwain, Wen-Hwa, and Hugh R. MacCrimmon (Dept. of Zoology, Univ. of Guelph, Guelph, Ontario, Canada). 1969. FURTHER OBSERVATIONS ON THE RESPONSE OF RAINBOW TROUT, Salmo gairdneri, TO OVERHEAD LIGHT. J. Fish. Res. Bd. Canada, 26(12): 3233-3237.

The response of rainbow trout (Salmo gairdneri Richardson) to overhead light changed with the growth of the fish. No response was evident until the age of 7 months, after which the response became more pronounced with age. Trout exhibited a significant preference for the darkest chamber when given a choice of five intensities of artificial light. Minimum light threshold for 10-month-old fish was between 0.01 and 0.005 lux. However, 24-month-old fish had a lower level of light threshold between 0.005 and 0.001 lux. (Authors)

12026. Rafail, Samir Zaky (Inst. of Oceanography and Fisheries, Kayed Bay, Alexandria, United Arab Republic). 1969. FURTHER ANALYSIS OF RATION AND GROWTH RELATIONSHIP OF PLAICE (Pleuronectes platessa). J. Fish. Res. Bd. Canada, 26(12): 3237-3241.

Evidence is given that the average daily rations (R) and fortnightly growth increments (ΔW) of six weight groups of Pleuronectes platessa fed on Mytilus edulis are related as in the power equation $\pm(\Delta W - \Delta W_m) = \pm b(|R - R_m|)^B$. R_m is the daily ration associated with the growth increment (ΔW_m) at maximum growth efficiency; b and B are parameters. The power B has a mean value of about 0.5 and shows significant deviations from the mean especially in the case of smaller fish. (Auth.)

12027. Wiles, Michael (Fisheries Res. Bd. of Canada, Biological Station, St. John's, Newfoundland, Canada). 1969. FIBROUS AND CYSTIC LESIONS IN THE OVARIES OF AGED ATLANTIC COD (Gadus morhua): A PRELIMINARY REPORT. J. Fish. Res. Bd. Canada, 26(12): 3242-3246.

Ovarian stromal fibrosis occurred in four Atlantic cod (Gadus morhua L.) from the northeastern Gulf of St. Lawrence (49°07'N, 59°18'W) and off Fox Harbour, Labrador (52°18'N, 55°52'W), with accompanying cystic lesions in two specimens. Externally the ovaries varied. Specimen 1 (115 cm fork length, age 18 years) possessed clear areas (0.5-1.5 mm) where the underlying stroma was relatively thin. Specimen 2 (107 cm, 19 years) possessed scattered cream or yellow nodules (<1 mm) and coalesced nodules (1.5-2.0 mm). Specimen 3 (118 cm, 19 years) had many colourless fluid-filled cysts (1.5-2.0 mm) and a few larger cysts (5.0 X 7.5-7.0 X 12.0 mm), the latter confined to the tapering posterior regions of the ovary. Specimen 4 (99 cm, 16 years) possessed large (up to 8 mm) multilocular cysts anteriorly. Stromal fibrosis occurred to varying degrees in each specimen, containing predominantly fibrinoid as identified by Mallory's PAH, Weigert's fibrin test, and retention of a PAS-positive reaction after incubation in alkaline trypsin. Widespread degeneration of ovigerous lamellae occurred in specimens 3 and 4. The condition of specimens 3 and 4 suggests involutional ovarian stromal fibrosis, but the endocrine studies necessary to confirm this opinion were not performed. (Auth.)

12028. Tibbo, S. N., and L. M. Lauzier (Fisheries Res. Bd. of Canada, Biological Station, St. Andrews, N.B., Canada). 1969. LARVAL SWORDFISH (Xiphias gladius) FROM THREE LOCALITIES IN THE WESTERN ATLANTIC. J. Fish. Res. Bd. Canada, 26(12): 3248-3251.

In February 1965, 47 larval swordfish were caught in three regions of the western North Atlantic: near Cape Hatteras, N. C.; off the east coast of Florida; and near the Virgin Islands. The captures were made in waters where the ranges of both temperature (23.4-25.6 C) and salinity (35.81-36.36%) were small. The data support the conclusions of other workers that swordfish spawn in an area west of the Straits of Florida and in the most southern part of the Sargasso Sea. (Authors)

12029. McIntyre, John D. (Dept. of Fisheries and Wildlife, Oregon State Univ., Corvallis, Oregon). 1969. SPAWNING BEHAVIOR OF THE BROOK LAMPREY, Lampetra planeri. J. Fish. Res. Bd. Canada, 26(12): 3252-3254.

The spawning behavior of the brook lamprey, Lampetra planeri (Bloch), was observed and photographed at the Berry Creek Experimental Stream Laboratory near Corvallis, Oregon. Observations and photographs were made from an observation booth constructed adjacent to the stream bed of Berry Creek. (Auth.)

12030. Truscott, B., and D. R. Idler (Fish. Res. Bd. Canada, Halifax Laboratory, Halifax, N. S., Canada). 1969. AN IMPROVED EXTENDER FOR FREEZING ATLANTIC SALMON SPERMATOZOA. J. Fish. Res. Bd. Canada, 26(12): 3254-3258.

A solution of chemical composition based on that of seminal plasma was an effective extender for Atlantic salmon spermatozoa; semen diluted to 20 volumes could be maintained at 4 C in an inactive but potentially motile condition for several days. Propylene glycol at concentrations between 7.0 and 12.5% protected sperm cells against freeze-thaw damage. The addition of glycine or albumin to the basic extender containing 7-12.5% propylene glycol or 10% dimethyl sulphoxide provided an extender meriting further development for the cryopreservation of salmonid spermatozoa. Fertilities of 5-19% were achieved with 10 frozen sperm samples diluted with such extenders. For frozen samples a method of fertilization with simultaneous addition of water and sperm to the eggs is proposed. (Authors)

12031. MacKelvie, R. M., and H. Artsob (Fisheries Res. Bd. of Canada, Halifax Lab., Halifax, N. S., Canada). 1969. INFECTIOUS PANCREATIC NECROSIS VIRUS IN YOUNG SALMONIDS OF THE CANADIAN MARITIME PROVINCES. J. Fish. Res. Bd. Canada, 26(12): 3259-3262.

Infectious pancreatic necrosis virus was isolated from young salmonids, including Atlantic salmon (Salmo salar), in 9 of the 13 fish culture stations of the Canadian Maritime Provinces. The virus was isolated in tissue culture and identified serologically. There was no evidence of Viral Hemorrhagic Septicemia (Egtved disease). (Authors)

12032. Lawler, G. H. (Fish. Res. Bd. of Canada, Freshwater Inst., Winnipeg, Manitoba, Canada). 1969. ACTIVITY PERIODS OF SOME FISHES IN HEMING LAKE, CANADA. J. Fish. Res. Bd. Canada, 26(12): 3266-3267.

On the basis of the numbers of fish caught per unit of time in Heming Lake during a spring-summer period, the white sucker (Catostomus commersoni) was most active during daylight. The following species were most active during darkness: northern pike (Esox lucius), whitefish (Coregonus clupeaformis), and walleye (Stizostedion vitreum vitreum). (Auth.)

12033. Utter, Fred M. (Bur. of Comm. Fish., Biological Lab., Seattle, Washington). 1969. TRANSFERRIN VARIANTS IN PACIFIC HAKE (Merluccius productus). J. Fish. Res. Bd. Canada, 26(12): 3268-3271.

Four transferrin bands were detected by starch-gel electrophoresis in serum and vitreous fluids of Pacific hake from Puget Sound, Washington, and off the mouth of the Columbia River. The patterns of the variants and their frequencies in samples from the two areas indicated that each band reflects one allele at a single locus. Frequencies of the alleles differed significantly between areas. (Auth.)

12034. Jenkins, Thomas M., Jr. (Bur. of Sport Fisheries and Wildlife, Sierra Nevada Aquatic Res. Lab., Bishop, California). 1969. NIGHT FEEDING OF BROWN AND RAINBOW TROUT IN AN EXPERIMENTAL STREAM CHANNEL. J. Fish. Res. Bd. Canada, 26(12): 3275-3278.

This study sought to determine if stream-living brown and rainbow trout (Salmo trutta and Salmo gairdneri) will feed on drifting terrestrial insects at night. Groups of fish were confined in segments of a rocky-substrate mountain stream, and marked ants were introduced to the current from observation towers

equipped with feeding tubes. After the last introductions of an experiment, the fish were removed and their stomachs were examined for marked ants. Although fish of both species fed at night, they appeared to take a smaller percentage of the ants provided than did day-feeding groups studied for comparison. Fish feeding under bright moonlight and starlight captured introduced ants at about the same rates. The results suggest that trout in the type of stream studied feed or are in feeding readiness at nearly all hours of the day or night, at least in the summer months. (Auth.)

12035. Hunt, Robert L. 1970. A COMPENDIUM OF RESEARCH ON ANGLING REGULATIONS FOR BROOK TROUT CONDUCTED AT LAWRENCE CREEK, WISCONSIN. Dept. of Natural Resources Research Report No. 54, Madison, Wisconsin, 37 p.

The major findings, conclusions and management implications derived during 13 years of testing and evaluating experimental angling regulations applied to the fishery for wild brook trout (Salvelinus fontinalis) in Lawrence Creek are presented. Four general types of regulations were tested: size limits, bag limits, fish refuges and restrictions on fishing methods. The size limit, if wisely applied, is the best single regulation for preventing excessive angler harvest of brook trout populations. A good "rule of thumb" is a size limit set at the length attained by 30% of the trout population in May, or 40% in June, or 50% in September (excluding age 0). This is 7 inches for the population in Lawrence Creek. Bag limits provide no protection until the limit is reached, and since most of the catch of wild brook trout consists of 1 or 2 trout/trip, very restrictive bag limits would be needed to substantially reduce the catch. Angling effort appeared to be influenced by restrictions on the catch. Angling regulations that allow some harvest or fishing opportunity every year from all fishable trout waters are clearly preferable to elimination of all fishing through creation of fish refuges. Fishermen were attracted by "fly fishing only" regulations, and enjoyed high quality fishing, but there was little difference in other aspects of the fisheries in the flies-only zone versus the any-lure zone, and no detectable responses by the trout populations due to the flies-only restriction. (Auth)

12036. Kudo, Hidero. 1964. A METHOD FOR THE DETERMINATION OF THE CONCENTRATION OF SULFIDES IN SEA WATER, AND THE CONCENTRATION OF SULFIDES IN SEA WATER IN MATSUSHIMA BAY. Bull. Tohoku Fish. Res. Lab. No. 24, pp. 1-7.

It has been pointed out that sulfides in sea water especially hydrogen sulfide are very toxic to marine animals. In Matsushima Bay, the content of sulfides in the bottom mud increased remarkably during the last ten years. But there are several technical difficulties in determining the trace concentration of sulfides in sea water of the Bay, due to the volume limit of the sample used, and interference by dissolved or suspended materials. To find a solution to these problems, a precipitating method of determining sulfides in sea water was examined by the addition of zinc chloride and sodium hydroxide as the precipitants. The amounts of sulfides condensed in the precipitates were determined by the iodometric or colorimetric method, after collection of the hydrogen sulfide eluted by nitrogen gas aeration. The concentration of the sulfides in sea water can be determined even to less than one microgram per liter of sulfide-S. At 14 stations in Matsushima Bay, the content of sulfides in the sea water was determined from June to September in 1964 by applying the above-mentioned method. The concentration of sulfide-S at the surface layer of stations 1 and 2 were 18.6-1,080.0, 81.0-3,960.0, γ/L, and those at the bottom layer of these stations were 0-67.5, 1.3-16.2 γ/L, respectively. Although 0-12.5 γ/L of sulfide-S was found at the other stations, the majority of them were less than about 2 γ/L or were zero. (Auth.)

12037. Bearden, Charles, M. 1963. A CONTRIBUTION TO THE BIOLOGY OF THE KING WHITINGS, GENUS Menticirrhus, OF SOUTH CAROLINA. Contributions from Bears Bluff Laboratories, No. 38, 27 p.

It may be concluded from this study that king whitings, particularly M. americanus, are in no immediate danger of serious depletion in South Carolina waters, in spite of increased fishing pressure in recent years. These fish have been able to maintain fairly steady population levels over the past eight years or so, and have even shown increases in numbers in the past several years. A major key to the success of the southern king whiting would appear to be the nature of the nursery areas in South Carolina. These areas are typically estuarine areas of tidal streams which are largely isolated and protected from the influence of man, where the young attain several months' growth before migrating seaward. It appears that as long as present conditions undergo no major changes, the southern king whiting will remain abundant in South Carolina waters. It is felt that the present study has yielded useful information on the biology of the king whitings, particularly on such items as seasonal and yearly abundance, distribution, food habits, and general ecology. However, additional research is needed, chiefly in such areas as spawning, fate of eggs and larvae, age and growth, seasonal and diurnal migrations, etc. The swimbladder of M. americanus and its relationship to the biology and life history of this species would comprise a worthwhile study in itself. (Auth. conclusions)

12038. Paulus, Robert D. 1969. WALLEYE FRY FOOD HABITS IN LAKE ERIE. Ohio Dept. of Natural Resources, Div. of Wildlife, Columbus, Ohio. Ohio Fish Monograph No. 2, 45 p.

Walleyes, Stizostedion vitreum vitreum, have been drastically reduced in western Lake Erie. Reasons for the population decrease are not known, but it is thought that environmental factors are somehow causing a reduction in numbers during the early fry stage. Fry and plankton collections were made in May 1964 and May 1965 at the Put-in-Bay Hatchery of the Ohio Division of Wildlife and in western Lake Erie near the major spawning areas of the walleye. Qualitative and quantitative plankton samples were taken concurrently with fry collections. Plankton organisms were randomly utilized by all of the observed fry. The smallest fry collected was 7.0 mm and the largest was 17.0 mm. Digestive tract analyses showed that fry of 9.0 mm or less total length ingested primarily diatoms. At about 9.0 mm, zooplankton became the principal food, although phytoplankton were utilized by fry of all observed sizes. As fry length increased, dependence on zooplankton increased and dependence on phytoplankton decreased. (Auth.)

12039. Yamamura, Yarokuro, and Seiichiro Muto. 1961. CHANGE OF VITAMIN A AND CAROTENOIDS DURING DEVELOPMENT OF THE SALMON EGGS. Bull. Tohoku Fish. Res. Lab., No. 19, pp. 171-179.

This report deals with the change of vitamin A and carotenoids, especially astaxanthin in the eggs of the Pacific salmon (Oncorhynchus keta) in the course of development. Live samples were brought to the laboratory from Otsuchi hatchery (Iwate prefecture) and analysis was made on the contents of dry matter, total nitrogen, lipids, vitamin A and astaxanthin. Vitamin A and its homologues were separated by means of gradient elution chromatography. Astaxanthin was chromatographed on cellulose powder, being eluted with petroleum ether containing 10 percent of acetic acid; then the extinction of 505 mμ wave length was measured (in CS_2) using HITACHI's EPU-II type spectrophotometer. Vitamin A existed in ester form before fertilization, and soon after the fertilized eggs contained about 2 i.u. of it per egg; it was consumed but little during hatching – in the hatching stage, the vitamin is contained mainly in the yolk sac – but a sudden drop of the amount was observed when the yolk sac was absorbed completely (when it just became the larval stage). The ester form of vitamin A changes to alcoholic form in the process of development, and at the final stage there remained only the ester form of Vitamin A. The amount of vitamin A consumed during development was about 1 i.u. per individual. The content of astaxanthin was about 1.6γ per egg and it dropped slowly from yolk to embryo and then to larva, but its consumption was not so large as vitamin A. Vitamin A aldehyde was not recognized in

this experiment. Analytical data of the general composition of the salmon eggs and those of the lipids are tabulated. (Authors)

12040. Machidori, Seiji. 1969. SEX RATIO OF COHO SALMON (Oncorhynchus kisutch) IN THE JAPANESE HIGH SEAS FISHERIES AND THE RUSSIAN COASTAL FISHERIES. Bull. Hokkaido Fish. Res. Lab. No. 35, pp. 7-19. (In Japanese with English abstract).

Some comparisons were made on the sex ratios of coho salmon caught by the Japanese high seas fisheries (1957-1967) and the Russian coastal fisheries (1961-1967) considering such factors as ages, regions, seasons, offshore and coastal, etc.. Sex ratios changed regionally and seasonally on the high seas. The proportion of males tended to increase northward and to decrease in the later fishing season. From this, it was presumed that males tended to preceed females in their spawning migration. Definite information for local populations could not be obtained from the view point of sex ratio on the high seas. However, discontinuous changes of sex ratios from west to east may suggest the existence of segregation of local populations. The sum total of offshore and coastal catches was almost the same in numbers of males and females in each age, respectively. However, males were slightly dominant in age 3_2 and females were slightly dominant in ages 4_3 and 5_4. It was supposed that the sex ratio of spawning population would not be disturbed by fishing.

12041. Fukataki, Hiroshi. 1967. STOMACH CONTENTS OF THE PINK SALMON, Oncorhynchus gorbuscha (Walbaum), IN THE JAPAN SEA DURING THE SPRING SEASON OF 1965. Bull. Jap. Sea Reg. Fish. Res. Lab., (17): pp. 49-66.

The stomach contents of 585 pink salmon, Oncorhynchus gorbuscha (Walbaum), collected from various localities in the Japan Sea during the spring season of 1965 by overnight surface driftnet were studied. The weight of the stomach contents was determined by weighing the stomach once with the contents and again with the contents removed, the difference being the weight of the contents. The stomach contents were examined in as much detail as possible; then each component of the diet was weighed. The predominant organisms in the diet were Parathemisto japonica Bovallius and Thysanoessa longipes F. P. Brandt, while young squid also played a rather important role. In addition, other groups, such as Euprimno macropa Guerin, Calanus cristatus Kroyer, zoea and megalops of crabs and fishes, were occasionally present in more than trace amounts. The relative importance of various food components or items in the diet of the pink salmon are shown. During the early months, P. japonica alone constituted the larger portion of the diet, but during the later months, T. longipes and squid also occupied a rather important portion. In comparison with the results of our previous studies on the stomach contents of the pink salmon in the Japan Sea, it is suggested that the food constitution and its successive changes during the spring season varied little among different years. P. japonica was eaten in the more open areas, while T. longipes in the somewhat limited areas. The localities of intensive feeding upon both species mentioned were different; for the former species, the warm Tsushima Current region located southeastward to the polar frontal zone, and for the latter, northwestward to the zone. Although the food items taken by the pink salmon in the North Pacific Ocean including a part of the Okhotsk and Bering Seas were similar to those taken in the Japan Sea, there are a few differences in the food make-up between the North Pacific Ocean and the Japan Sea. Fishes, copepods and pteropods were scarce or negligible in the make-up in the Japan Sea, while they occasionally occupied the important or larger portion in the make-up in the North Pacific Ocean. It may be considered that the make-up of the diet of the pink salmon is mainly affected by the faunal characteristics of the macroplankton and micronekton distributed in habitats of the predator.

12042. Kato, Mamoru. 1968. ON DIFFERENCES AMONG THE SCALE CHARACTERS TAKEN FROM VARIOUS BODY PARTS OF THE PINK SALMON, Oncorhynchus gorbuscha (Walbaum). Bull. Jap. Sea Reg. Fish.Res. Lab. (19): pp. 61-64. (In Japanese).

12043. Fukataki, Hiroshi. 1968. RECORDS OF THE SOUTHERNMOST RANGE OF THE CHINOOK SALMON, Oncorhynchus tschawytscha (Walbaum), IN THE JAPAN SEA, WITH SPECIAL CONSIDERATION ON THEIR ORIGINS. Bull. Jap. Sea Reg. Fish. Res. Lab., (19), pp. 29-41.

In this paper, five records showing the southernmost range limit of the chinook salmon in the Japan Sea are reported, and their origins are discussed. On May 31, 1967, a salmon specimen identified as Oncorhynchus tschawytscha (Walbaum) was caught by a trapnet at Nozumi, Teradomari Town, Niigata Prefecture (37°40'N lat.; 138°46'E long). The fish was 102 cm in fork length, 13.85 kg in body weight and it was a female with mature ovary (ovarian weight was 1.33 kg). It was reported earlier by a local newspaper "Niigata Nippo" that two specimens of this species, one each in 1962 and 1965, were caught in the coastal waters of Ryotsu Bay, Sado Island. From examination of the records, it has been found by the author that upstream migration of the chinook salmon occurred at least twice (in 1912 and 1958) in the Miomote River, which drains into the Japan Sea at 38°14'N lat. During the years from 1959 to 1963, eyed eggs of the chinook salmon were transplanted from the United States of America to Hokkaido to establish a new stock, and the hatched fry were released in the Tokachi River during the spring season of each succeeding year. Therefore, it is of interest to establish whether the origins of the specimens caught in 1962, 1966 and 1967 are from transplantation. The age of the specimen collected from Nozumi in 1967 was determined as 5_1 fish which had migrated to the sea in 1963 and spent four winters in the ocean. Unfortunately, since no marking (fin clipping) was made for the only year class of the fry which were transplanted in 1962 and released in 1963, no conclusion on the origin could be made, even though each fin of the specimen was complete. Since the two specimens caught in 1962 and 1966 were as large as the one caught in 1967, they were assumed to be 5_1 fish. Thus, it is clear that the origin of the specimen caught in 1962 was independent of transplantation, which started in 1959. From the photograph of the specimen caught in 1966, it is evident that both ventral fins of the fish were normal, whereas the adipose and both ventral fins of the hatched fry were clipped before release in the corresponding year (1962). Therefore, the origin of the specimen was independent of transplantation. (Auth.)

12044. Kato, Mamoru. 1968. A CHARACTER SHOWING THE DIFFERENT MIGRATION COURSES AND TIME OF ANNUAL FORMATION ON SCALES OF THE PINK SALMON, Oncorhynchus gorbuscha (Walbaum), COLLECTED FROM THE JAPAN SEA. Bull. Jap. Sea Reg. Fish. Res. Lab., (19), pp. 19-28.

Scale samples of 3,276 pink salmon, Oncorhynchus gorbuscha (Walbaum), collected from various localities in the Japan Sea during the spring seasons of 1965 and 1966, were examined under a microprojector at 100 magnifications. In both years, the main fishing grounds for pink salmon in the Japan Sea were separated into two parts. The western fishing ground was separated from the eastern ground by the line about along longitude 136°E. It is of interest to determine whether these two fishing grounds correspond to two distinct stocks having different native areas. For this purpose, scale samples were grouped according to localities and date of sampling, into three categories: (A) east of 136°E, up to early May (in 1965) or mid May (in 1966); (B) east of 136°E, after mid May or late May; (C) west of 136°E, through the whole sampling period. The relationship between number of circuli and mean fork length evidently differed between (A) and (C), but no significant differences were found between (C) and (B). Consequently, it is suggested that pink salmon in the Japan Sea may be separated into two groups traveling on different migration routes. One of these groups migrates northward along the west coast of northern Honshu and Hokkaido during the earlier fishing season, whereas the other group appears first in the offshore waters comparatively near Korea; thereafter, it travels northeastward across the line of 136°E. The average number of circuli on the scales became progressively larger with later sampling dates. The ratio of the increase was 0.9 circuli per ten days. Applying this ratio to the period before the start of sampling, it is estimated that the annuli on the scales of the majority of pink salmon were formed during the period from late November to mid December. (Auth.)

12045. Bearden, Charles M. 1967. FIELD TESTS CONCERNING THE EFFECTS OF "DIBROM 14 CONCENTRATE" (NALED) ON ESTUARINE ANIMALS. Contributions from Bears Bluff Laboratories, No. 45, 14 p.

The field tests described in this paper indicate that Dibrom 14 Concentrate, applied by thermal fogging or by aerial application in concentrations normally used for marshland mosquito control, had little or no observable effect on test animals held in their natural environment, although this pesticide has been found to be quite toxic to shrimp under confined conditions. Aside from the fact that in these tests little mixing of Dibrom with the water probably took place, a number of factors are present in the natural environment which would tend to influence the concentration of the pesticide that the animals were actually exposed to. The most obvious of these are as follows: (A) Adsorption or absorbtion of Dibrom by particles suspended in natural waters, such as detritus, silt, and planktonic organisms. (B) Adherence of the spray to the stems and leaves of Spartina alterniflora, which abounds in the marsh area. (C) Tidal flow and flushing. Since slack water lasts for only a few minutes of either high or low tide, some tidal flow occurred during all field tests, introducing an incalculable dilution factor. (D) The fact that the experimental animals were enclosed in cages of fine netting could have had some effect on the penetration of the pesticide. Results of these tests indicate that, except under confined conditions, such as in shallow non-tidal areas or perhaps at extreme low water, little mortality would be caused through use of this pesticide. Since Dibrom hydrolyzes in a short period, is relatively insoluble in water and is applied normally in small concentrations, it would appear to be preferable to many insecticides now in use, particularly those belonging to the more stable chlorinated hydrocarbon group, such as DDT or Dieldrin. Laboratory tests have indicated that spot (L. xanthurus) suffered no chronic effects during long term exposure to sublethal dosages of a related compound (Malathion) and that cholinesterase activity of the brain returned to near normal in one week after the exposure period. It is possible that exposure to Dibrom would also have no chronic effects on estuarine animals, but this aspect needs considerable investigation before any definite conclusions along those lines can be made. (Auth.)

12046. Cameron, James N. (The Univ. of Texas Marine Science Inst. at Port Aransas, Texas). 1969. GROWTH, RESPIRATORY METABOLISM AND SEASONAL DISTRIBUTION OF JUVENILE PINFISH (Lagodon rhomboides Linnaeus) IN REDFISH BAY, TEXAS. Contributions in Marine Science, Vol. 14, pp. 29-36.

The abundance of pinfish on a grass flat area of Redfish Bay, Texas, increases rapidly in late winter, reaches a spring peak and declines through the remainder of the summer and falls to low levels in winter. Pinfish are absent altogether during brief periods in mid-summer and -winter when temperatures exceed lethal levels. Nearby deeper channels provide refuge at these times. Metabolic rates of the pinfish are effectively temperature compensated. The overall Q_{10} value for the year is about 1.7, but within-season temperature responses are larger. Metabolic depression is evident at temperatures near lethal limits and depression was observed at periods when movements to other more favorable areas occurred. The period of rapid growth corresponds to times of maximum pinfish density on the grass flats and growth proceeds at a low rate during winter. Comparison of growth rates from several other areas shows differences of nearly two-fold in length at the end of the first year. At least some of these differences can be explained on the basis of location and timing of samples from the various areas, as well as size-related movements that occur seasonally. (Auth.)

12047. Lie, Ulf (Dept. of Oceanography, Univ. of Washington, Seattle, Washington). 1968. A QUANTITATIVE STUDY OF BENTHIC INFAUNA IN PUGET SOUND, WASHINGTON, USA, IN 1963-1964. FiskDir. Skr. Ser. HavUnders., 14(5): 229-556. Publisher: Universitetsforlaget Trykningssentral, Oslo, Norway.

12048. Naevdal, Gunnar (Institute of Marine Research, Bergen, Norway). 1969. STUDIES ON SERUM ESTERASE IN HERRING AND SPRAT. FiskDir. Skr. Ser. HavUnders., 15(2): 83-90.

Herring and sprat serum esterase has been studied by combined starch and agar gel electrophoresis at pH 9.0. Both strong and weak bands which represented esterase activity occurred in both species. Most herring specimens contained one strong component of intermediate anodic mobility. Two strong components of higher and two of lower anodic mobility occurred at low frequencies. A hypothesis of genetical control by one gene controlling each of the components is proposed. Maximum six weak bands of herring serum esterase were found. Considerable variations among specimens occurred in these bands. No theory of genetic control of the total variations can be given at present, but two codominant alleles may be responsible for the variation in two of the weak bands. The intraspecific variations in sprat serum esterase were complicated, and it was difficult to classify the specimens into well defined groups on basis of these variations. A hypothesis of control by two allelic genes of the variations in two of the components is introduced. Frequency variations among some of the samples of both species were indicated. (Auth. summ.)

12049. Møller, Dag, and Gunnar Naevdal (Institute of Marine Research, Bergen, Norway). 1969. STUDIES ON HEMOGLOBINS OF SOME GADOID FISHES. FiskDir. Skr. Ser. HavUnders., 15(2): 91-98.

Hemoglobin of tusk, forked hake, ling, blue ling, hake, pout, Norway pout, pollack, coalfish, haddock and blue whiting were studied by agargel electrophoresis. Both inter- and intraspecific variations in hemoglobin patterns occurred. Intraspecific variations were found in tusk, ling, blue ling, pollack, coalfish (only one specimen differed from the "normal" pattern), haddock and blue whiting. A hypothesis of genetical control involving two allelomorphic genes is proposed to explain the variations within each species. The population data coincided with this hypothesis. No indication of ontogenetic variation of hemoblobin patterns has been found. Frequency variations of the hemoglobin types in ling indicate segregation in the population structure. (Authors summ.)

12050. Sanderson, Charles (Pennsylvania Fish Commission, Pleasant Mount Fish Cultural Station, Pennsylvania). 1969. RESULTS OF FEEDING DAPHNIA TO MUSKELLUNGE OVER A PROLONGED PERIOD. Notes for Fish Culturists, From the Benner Spring Fish Research Station, 4 p.

It has long been the accepted belief among fish culturists that young muskellunge must be fed minnow or sucker fry as soon as they will accept them. An experiment was designed to determine the effect on survival and growth of muskellunge if they were not advanced beyond a diet of zooplankton. The fry receiving daphnia grew slowly but appeared normal in both behavior and physical condition until they reached a length of approximately 5 cm. As the experiment progressed the fry feeding on daphnia became somewhat emaciated but there were very few mortalities and no cannibalism was observed. In comparison the control lot, which received minnows, fed vigorously and grew rapidly. It appears that it is possible to feed a diet of one hundred percent daphnia to muskellunge for at least five months with no significant mortality. Survival is very good but growth is significantly retarded. After a length of 5 cm is attained the daphnia diet does not appear adequate. It is possible that it would be beneficial to hold muskellunge on a diet of daphnia somewhat longer than is now the practice. This would allow sufficient time for spawning of minnows and assure an ample supply of forage fish for use in tank culture.

12051. Bearden, Charles M. 1964. DISTRIBUTION AND ABUNDANCE OF ATLANTIC CROAKER, Micropogon undulatus, IN SOUTH CAROLINA. Contributions from Bears Bluff Laboratories No. 40, 23 p.

12052. Ando, Kazuo. 1968. BIOCHEMICAL STUDIES ON THE LIPIDS OF CULTURED FISHES. J. Tokyo Univ. Fish., 54(2): 61-98. (In Japanese with English contents).

Contents: Analysis of chemical components of the rainbow trout egg and their changes during development; analysis of acetone insoluble lipids in the rainbow trout egg and their changes during development; gas-chromatographic analysis of fatty acids in triglycerides and phospholipids of the rainbow trout egg and their changes during development; ultracentrifugal analysis of yolk proteins of rainbow trout eggs and their changes during development; and influence of different dietary lipids on the fatty acid compostiion of the eel.

12053. Kramer, Robert H. (Utah State Univ., Cooperative Fishery Unit, Logan, Utah). 1969. A PRELIMINARY BIBLIOGRAPHY ON EXTENT AND CAUSES OF EARLY MORTALITY IN FRESHWATER FISH (DIADROMOUS FISHES EXCLUDED). FAO of the United Nations, Rome, FAO Fisheries Circular No. 307, 20 p.; Selected Water Resources Abstracts, 3(8): 31-32, April 1970.

Published data overwhelmingly support the hypothesis that strength of year-class in freshwater fishes is established very early in their life history, often prior to the completion of the larval period. This preliminary bibliography, comprising some 191 entries, documents this hypothesis. It was compiled for circulation among specialists, with objective of soliciting for suggestions, corrections, and additions. Citations are largely from the English-language literature published between 1886 and 1968, of which approximately 51% were published in the decade beginning 1960. The following headings are included in a subject index (with number of citations pertaining to each indicated in parentheses): Behavior (8); bottom type (6); commensal spawning (6); disease (3); dissolved oxygen (15); food (16); fungus (3); groundwater (2); hydrogen sulfide (2); light (10); morphology (5); pollution (15); population density (2); predation and cannibalism (21); radiation (2); salinity (1); siltation (4); water level (18); water temperature (48); wind and wave action (6). A species index is also provided. -- Eichhorn

12054. Dannevig, Gunnar (Statens Biologiske Stasjon Flødevigen). 1963. ARTIFICIAL PROPAGATION OF COD. SOME RESULTS OF THE LIBERATION OF LARVAE. FiskDir. Skr. Ser. HavUnders., 13(6): 73-79.

The methods developed by G. M. Dannevig (1910) for hatching cod eggs on a large scale have proved to be very efficient and have been used unaltered up to the present time. Material now at hand indicates that the liberation of larvae has a noticeable effect on the abundance of young cod in the Oslofjord district. The results indicate that the artificial propagation of cod may prove profitable when concerned with local stocks that are heavily exploited by fishing.

12055. Berge, Grim (Inst. of Marine Research, Bergen, Norway). 1969. PREDICTED EFFECTS OF FERTILIZERS UPON THE ALGAE PRODUCTION IN FERN LAKE. FiskDir. Skr. Ser. HavUnders., 15(3): 339-355.

With the object of predicting effects of different amounts of fertilizers upon the rate of primary production in Fern Lake, (State of Washington), a bioassay was carried out in a series of 14 twenty-liter glass carboys. The experiment revealed that the rate of gross production increased nearly proportionally with the amounts of fertilizers added and a maximum increase of 180 times the original rate of gross production was obtained. When iron was included with the fertilizers colloidal substances were formed acting upon the transparency of the water. When it was excluded it became limiting on the rates of primary production. It is demonstrated that due to reduced transparency the inclusion of 100 ppm iron would not increase the total primary rate of production of the lake any further. Suggestions for the fertilization of Fern Lake are given. (Auth. summ.)

12056. Sundnes, Gunnar, Per Bratland, and Elsa Strand (Institute of Marine Research, Bergen, Norway). 1969. THE GAS CONTENT IN THE COREGONID SWIMBLADDER. FiskDir. Skr. Ser. HavUnders., 15(3): 274-278.

The present investigation supports the theory that there are no differences in the swimbladder physiology of Coregonus acronius in the Bodensee and Coregonus lavaretus in Randsfjord. The high N_2 content found in C. acronius is due to absorption of the O_2 content of the swimbladder. (Authors summ.)

12057. Nikolsky, Georgy V. (Inst. of Animal Evolutionary Morphology and Ecology, USSR Academy of Sciences, Moscow, USSR). 1969. INTRASPECIFIC STRUCTURE AND VARIABILITY IN RELATION TO FISHERIES MANAGEMENT. FiskDir. Skr. Ser. HavUnders., 15(3): 259-265.

Every animal species is relatively stable in time and space. This relative stability is provided by adaptive intraspecific variability which makes it possible for the species to exist under certain changes of its biotic and abiotic environment. Species is an open self-regulating system. Eurybiont species usually possess a more complex intraspecific structure and a wider range of self-regulation mechanisms than stenobiont species adapted to more stable conditions. The knowledge of specific structure as well as its regulatory parameters is essential for rational exploitation of commercial species populations and the ensurement of their reproduction. The most essential system of regulatory mechanisms manifests itself in food supply and reproduction rate variability. Disturbances in this regulatory system affect recruitment and bring about a lack in resources of the given commercial species, i. e. overfishing in the biological sense. An essential regulatory mechanism which secures the existence of the species is an adaptive morphological variability of its specimens. Every year-class is somewhat distinguishable from adjacent year-classes due to the specificity of its living conditions. At the same time adjacent year-classes specifically in the species with a long life cycle mutually interact, affecting the growth rate, fecundity and other year-class characters. In specific structure the relationships between intraspecific forms is its essential property. To meet the requirements of fisheries, not only the information of the size and properties of the different species forms are essential, but also the possibilities of reproduction of one of the forms by another, i. e. the character of their relationships. The knowledge of the peculiarities of commercial species regulatory mechanisms and their structure are prerequisite for developing productive fishery. (Auth. conclusion)

12058. Craig, Robert E., and Sinclair T. Forbes (Marine Laboratory, Aberdeen, Scotland). 1969. DESIGN OF A SONAR FOR FISH COUNTING. FiskDir. Skr. Ser. HavUnders., 15(3): 210-219.

The paper describes: (a) a very high resolution echo-sounder; (b) a method of sorting echoes by amplitude and range; (c) a study of the analysis required to transform from distribution of echoes to distribution of targets. Under (a) the main parameters were – frequency 400 kHz – range resolution 15 centimetres – beam angle to half-power point 0.011 radians. The equipment for recording echoes (b) is a pulse height analyser. Echo information is stored in twenty range intervals, each subdivided into 20 categories of amplitude. It was shown (c) that the process of determining target distribution from echo distribution can be dealt with by computer, and resolves itself into a correction for angular spread of the beam, followed by a transformation to allow for the directivity pattern. This latter transformation is equivalent to solving twenty simultaneous linear equations for each range element. The coefficients of the equations are constants for the equipment, thus the set can be solved once, and the result applied to each successive range element by a simple program. (Authors summ.)

12059. White, Ronald L., John T. Lane, Paul E. Hamer (Nacote Creek Research Station, Star Route, Absecon, New Jersey). 1969. POPULATION AND MIGRATION STUDY OF MAJOR ANADROMOUS FISH. N. J. Dept. of Conservation and Economic Development Miscellaneous Report No. 3 M, 6 p., tables and maps.

12060. Mathisen, Ole A. (College of Fisheries, Univ. of Washington, Seattle, Washington). 1969. GROWTH OF SOCKEYE SALMON IN RELATION TO ABUNDANCE IN THE KVICHAK DISTRICT, BRISTOL BAY, ALASKA. FiskDir. Skr. Ser. HavUnders., 15(3): 172-185.

Catch and escapement of Kvichak River sockeye salmon (Oncorhynchus nerka) and smolt production from Iliamna Lake, the nursery area, have been determined annually since 1955. Since 1962, information has been collected on growth and abundance of fry and yearlings and zooplankton production in Iliamna Lake. Growth in length of smolts can be expressed as a negative exponential function of population density. A similar relationship exists for maturing salmon on their return from the ocean to the Kvichak River. There is no strong correlation between the growth of juvenile salmon in Iliamna Lake nursery area and the standing crop of zooplankters. Other effects of crowding on growth need to be investigated. An asymptotic limit for the number of smolts produced in the nursery area has been computed, but it may be valid only for a single-peak cycle, the current pattern of run variability in the Kvichak River. (Auth. summ.)

12061. Naevdal, Gunnar (Institute of Marine Research, Bergen, Norway). 1969. STUDIES ON BLOOD PROTEINS IN HERRING. FiskDir. Skr. Ser. HavUnders., 15(3): 128-135.

Hemoglobins and serum proteins of herring have been analyzed by agar gel electrophoresis (hemoglobins) and combined starch and agar gel electrophoresis (serum proteins). The material comprises twelve samples from the Norwegian coast and the North Sea and one sample from the east coast of Canada, a total of 1,546 specimens. Intraspecific variation was noted in the transferrin components. Three common transferrin types were found and assumed to be controlled by two allelomorphic genes. No relation to age or length was found. Presence of additional weak components complicated the type determination. Hemoglobins in the sera as well as prolonged storage made the type determination unreliable. Observed albumin variations could be explained assuming control by two alleles, while observed variations in other serum protein groups were too weak or too diffuse for classification. A broad and diffuse band was found on the electrophoretograms from ripe females. Considerable variations in the frequencies of the genes supposed to control the transferrin types were observed among samples. The type determinations were complicated in some specimens, but the observed variation was greater than what could be explained by incorrect type determination or sampling error. The variation therefore probably represents real differences among population units. (Auth. summ.)

12062. Cushing, David H. (Fisheries Lab., Lowestoft, Scotland). 1969. THE FLUCTUATION OF YEAR-CLASSES AND THE REGULATION OF FISHERIES. FiskDir. Skr. Ser. HavUnders., 15(3): 368-379.

There are three sources of variation of recruitment; first that due to random fluctuations alone, secondly that due to variations in stock, and thirdly variations which are extreme at low and high levels of stock - and if these occur sequentially can cause catastrophic declines or sharp increases in stock density. From a study of stock/recruitment curves of a number of fish species, it appears that the curve for herring-like fishes differs markedly from those, for example, of cod-like fishes, or in more general terms, that the shape of the stock/recruitment curve is really a function of its fecundity. That for the herring-like fishes is a near linear curve whereas that for the cod-like fishes is markedly dome-shaped. It follows that the herring-like fishes are very vulnerable to long-term climatic changes and that the cod-like fishes are able to stabilize their populations through long-term climatic changes merely because the increased recruitment when stock is slightly reduced is very much greater than that for the herring-like fishes. If stocks of fish are to be managed then the stock/recruitment relationship has to be taken into account; a form of self regenerating yield curve combining stock/recruitment and yield-per-recruit was in fact put forward by Beverton and Holt. A development of such a curve is needed and one of the uses of such a curve would be that management need not take too much notice of environmental change, because if it occurred the stock would have been exploited at its best rate before any environmental collapse took place. (Auth. summ.)

12063. Paterson, C. G., and C. H. Fernando (Dept. of Biology, Univ. of Waterloo, Waterloo, Ontario, Canada). 1970. BENTHIC FAUNA COLONIZATION OF A NEW RESERVOIR WITH PARTICULAR REFERENCE TO THE CHIRONOMIDAE. J. Fish. Res. Bd. Canada, 27(2): 213-232.

At the time of first filling of Laurel Creek Reservoir in the spring of 1967 the benthic fauna consisted of submerged terrestrial organisms and obligate and facultative rheophilic species. Two months after initial filling substantial populations of colonizing limnophilic species developed in the habitat whereas the terrestrial and obligate rheophilic components were lost. By the 4th month the fauna was dominated by eruyoxybiontic limnophiles and by facultative species. In the period immediately prior to reservoir drainage in the autumn of 1967 the population densities of the euryoxybiontic chironomids declined whereas polyoxybiontic species continued to increase in abundance. These changes in the dominance hierarchy of the chironomid fauna were associated with the partial loss of the rich deposits of organic debris by siltation and decomposition. Survival of winter drainage of the reservoir by many limnophilic species produced an appreciably different pattern of colonization when the reservoir refilled in 1968. During the second summer of the reservoir's existence most euryoxybiontic chironomids further declined in abundance and were replaced by polyoxybiontic forms as the dominant species. The facultative species originally derived from the creek fauna are adapted to a wide range of environmental conditions and the modifications of the reservoir habitat with time had little effect on their abundance. (Authors)

12064. Amend, Donald F. (Bur. of Sport Fisheries and Wildlife, Western Fish Disease Lab., Sand Point Naval Air Station, Seattle, Washington). 1970. CONTROL OF INFECTIOUS HEMATOPOIETIC NECROSIS VIRUS DISEASE BY ELEVATING THE WATER TEMPERATURE. J. Fish. Res. Bd. Canada, 27(2): 265-270.

Studies were performed to determine if increasing water temperatures could control infectious hematopoietic necrosis virus (IHN) disease in sockeye salmon (Oncorhynchus nerka). Mortalities could be prevented if the water temperature was raised to at least 18 C within the first 24 hr after infection of the fish and if the fish were maintained at this temperature for 4 - 6 days. The disease did not recur after the elevated temperature treatment, but the fish would still contract the disease if they were reinfected. Reasons for the protecting action are discussed. (Auth.)

12065. Freese, M. (Fish. Res. Bd. of Canada, Freshwater Institute, Winnipeg, Manitoba, Canada). 1970. DISTRIBUTION OF Triaenophorus crassus PARASITES IN WHITEFISH FLESH AND ITS SIGNIFICANCE TO AUTOMATIC DETECTION OF THE PARASITES WITH ULTRASOUND. J. Fish. Res. Bd. Canada, 27(2): 271-279.

The three-dimensional distribution of Triaenophorus infection in the whitefish (Coregonus clupeaformis) body and the ultrasonic echoes received from the parasite cysts are studied in relation to the problem of detecting the parasites with ultrasound. It is shown that ultrasonic scanning of only 15% of the total surface area of a whitefish is required to illuminate (on the average) 70% of the total number of cysts in the body. As a result the search effort required for effective ultrasonic parasite detection can be greatly reduced. A considerably larger ratio of infection (3:2) for the right andleft sides of the body is observed than has been previously reported. It is also shown that in the epaxial muscles a parasite is much more likely to be encysted near the surface than deep inside the flesh. Measurements of the ultrasonic cyst-echo durations yielded a distribution with two peaks of different amplitudes indicating a preponderance of spindle-shaped cysts as is actually observed. A negligible percentage of the echoes in the distribution are less than 2 μsec in duration; the median width is 6.4 μsec. An outline is given of how these findings can be used to reduce the error rate in an automatic detection system. The paper concludes with a brief discussion of the effects of the transducer aperture on the latter distribution. (Auth.)

12066. Narver, David W. (Fish. Res. Bd. of Canada, Biological Station, Nanaimo, B. C., Canada). 1970. DIEL VERTICAL MOVEMENTS AND FEEDING OF UNDERYEARLING SOCKEYE SALMON AND THE LIMNETIC ZOOPLANKTON IN BABINE LAKE, BRITISH COLUMBIA. J. Fish. Res. Bd. Canada, 27(2): 281-316.

The use of a high frequency echo sounder and a midwater trawl in Babine Lake, British Columbia, in 1967 revealed a precise diel vertical movement of underyearling sockeye salmon. From early July to September, from about 1.5 hr after sunrise to 1.5 hr before sunset, the young sockeye were in two distinct layers at about 20 and 35 m, each layer about 6 m thick. About 1.5 hr before sunset the two layers began to ascend. About 0.5 hr after sunset all fish were within 3 m of the surface, and during darkness they were dispersed throughout the top 5-15 m with most fish being below the thermocline. Soon after the first light of dawn the fish usually tended to move toward the lake surface and then descended rapidly to the daytime depths. By early October the pattern had changed markedly. During daylight the fish were still found in roughly two layers at about 24 and 40 m. However, the evening ascent did not commence until about 0.5 hr before sunset, the ascent was much slower, and the fish did not come to the surface but were dispersed between 9 and 27 m. This change in behaviour was temporally associated with a cooling of the epilimnion and a decrease in intensity of feeding. Although the zooplankton of Babine Lake is composed of eight major species, only Bosmina coregoni and the calanoid copepod Heterocope septentrionalis displayed pronounced diel vertical movements. The former inhabited the surface waters during the day and were found in maximum abundance at 12-21 m at night. The latter was found at 21-30 m during the day and the surface waters at night. The major part of the zooplankton standing stock was found above 9 m. Young sockeye fed most intensively in the evening as they approached the surface and again at dawn just as they commenced the descent. At those times the most common food item was Daphnia longispina, followed by B. coregoni and H. septentrionalis. These three species were strongly selected by young sockeye, since they were numerically much less abundant than other limnetic zooplankton species. In August, terrestrial insects were occasionally of major importance. At midday the upper layer of sockeye (about 20 m) was feeding on H. septentrionalis whereas the lower layer (about 35 m) was not feeding or was feeding at a low intensity. The double layer of young sockeye during daylight occurred at least in the North Arm of Babine Lake and may be related to feeding. In July and August the fish in the upper layer had less food in the pyloric section of the stomach from 0900 to 1300 hr than did fish in the lower layer, whereas the volumes of food were similar in the two layers by late afternoon. Fish in the upper layer had much more fresh H. septentrionalis in the cardiac section from 1200 to 1800 hr than did fish in the lower layer. The ecological significance of the diel vertical movement is discussed briefly. (Auth.)

12067. Calaprice, J. R., and F. P. Calaprice (Fish. Res. Bd. of Canada, Biological Station, Nanaimo, B. C., Canada). 1970. MARKING ANIMALS WITH MICRO-TAGS OF CHEMICAL ELEMENTS FOR IDENTIFICATION BY X-RAY SPECTROSCOPY. J. Fish. Res. Bd. Canada, 27(2): 317-330.

This report describes a method of marking living organisms. As an illustration of the method, foreign chemical elements are incorporated into small salmon and the analytical technique of X-ray fluorescence spectroscopy is used to detect and measure minute quantities in the tissues. Mixtures of elements, either in equal or varying concentration, are used to generate a code. Decoding is readily accomplished by irradiating the tagged organisms and monitoring the X-ray fluorescence produced. A large number of unique combinations appear possible using the method as described. Mixtures of chemical elements (atomic numbers 37-69) were suspended in silicone rubber and injected directly into fish tissue. In this manner tags 1 mm^2 in area were incorporated in the tissue and decoded by nondestructive analysis. (Authors)

12068. Anderson, J. M., and H. B. Prins (Fish. Res. Bd. of Canada, Biological Station, St. Andrews, N. B., Canada). 1970. EFFECTS OF SUBLETHAL DDT ON A SIMPLE REFLEX IN BROOK TROUT. J. Fish. Res. Bd. Canada, 27(2): 331-334.

Brook trout were conditioned in about 30 trials to exhibit the propeller-tail reflex, with electric shock as the unconditioned stimulus and light as the conditioning stimulus. When the trout were exposed for 24 hr to sublethal DDT (20 ppb), more than half could not be conditioned at all; the remainder required significantly more trials than did the untreated ones. Three to four weeks after initial testing, the DDT effect had largely disappeared. It seemed likely that the DDT was acting upon central nervous system structures. The general ecological implications of the results are discussed. (Authors)

12069. Buhler, Donald R., and W. E. Shanks (Bur. of Sport Fisheries and Wildlife, Fish-Pesticide Res. Lab., Columbia, Missouri). 1970. INFLUENCE OF BODY WEIGHT ON CHRONIC ORAL DDT TOXICITY IN COHO SALMON. J. Fish. Res. Bd. Canada, 27(2): 347-358.

Median Survival Time was directly proportional to body weight in young coho salmon of the same age that were fed a diet containing technical DDT. Supplementation by additional feeding with DDT-free diet prolonged the lifespan of these fish but the Median Survival Time remained a direct function of body weight. The primary effect of body size on lethality was to control the rate of DDT intake by the fish. The smallest fish consumed the greatest amounts of diet and, consequently, these fish received the highest milligram per kilogram doses of DDT. In addition, however, the smaller salmon succumbed to a lower milligram per kilogram cumulative lethal dose than did the larger fish, perhaps because the smallest fish contained a lower percentage of lipid and thus failed to provide for adequate storage detoxification of the DDT. (Authors)

12070. McLay, Colin (Dept. of Zoology, Otago Univ., New Zealand and Inst. of Animal Resource Ecology, Univ. of British Columbia, Vancouver, B. C., Canada). 1970. A THEORY CONCERNING THE DISTANCE TRAVELLED BY ANIMALS ENTERING THE DRIFT OF A STREAM. J. Fish. Res. Bd. Canada, 27(2): 359-370.

Stream bottom animals were introduced into a stream by disturbing the gravel at increasing distances upstream from a drift sampler. The relationship between the number of animals arriving at the sampler and distance of origin of the animals was found to be $N_x = N_o e^{-RX}$ where N_o is the number of animals introduced, R is the rate of return to the gravel of the animals, and X is the distance upstream from the sampler. The maximum distance travelled was 45.7 m and the mean distance 10.7 m. The values of R for individual species ranged from 0.0517 to 1.962 and values of the mean distance travelled from 19.3 to 0.5 m. Specific differences could be accounted for by differences in structure or behavior of the animals. From these observations, a model of stream drift is developed. Two previously published experiments are shown to conform to model relationship: (1) recovery of drift density downstream from a blockage; and (2) distribution of times taken to regain a foothold on the substrate by mayfly nymphs released into a current. Since a stationary feeding fish such as a trout can be considered to be a "drift sampler" intercepting particles in the current, some suggestions are made about the development of a theory concerning the delivery of items of food to such a predator. (Auth.)

12071. Druehl, Louis D., and John M. Green (Dept. of Biological Sciences, Simon Fraser Univ., Burnaby, B. C., Canada). 1970. A SUBMERSION-EMERSION SENSOR, FOR INTERTIDAL BIOLOGICAL STUDIES. J. Fish. Res. Bd. Canada, 27(2): 401-403.

An instrument for use in intertidal biological studies that determines, at any instant, whether a given intertidal site is under or above water is described. The instrument measures microsubmersions and microemersions caused by surf. (Authors)

12072. Vanstone, W. E., J. R. Markert, D. B. Lister, and M. A. Giles. (Fish. Res. Bd. of Canada, Vancouver Lab., Vancouver, B. C., Canada). 1970. GROWTH AND CHEMICAL COMPOSITION OF CHUM (Oncorhynchus keta) AND SOCKEYE (O. nerka) SALMON FRY PRODUCED IN SPAWNING CHANNEL AND NATURAL ENVIRONMENTS. J. Fish. Res. Bd. Canada, 27(2): 371-382.

A comparison was made of the weights, lengths, weight-length relations, and chemical composition in migrating chum and sockeye fry resulting from eggs incubated and hatched in natural and artificial streams. Additionally, growth rates and rates of change in some chemical constituents were investigated in postmigrant channel- and river-hatched chum salmon confined to floating pens in sea water and in postmigrant sockeye salmon captured from their lake nursery area. There were no apparent differences in the lengths, weights, weight-length relations, or chemical composition between river- and channel-hatched chum salmon migrants. Nor was there any difference in the rates of change in length, weight, or chemical composition of these two groups of chums when confined to pens in sea water for 10 weeks after migration. There were differences in the weight-length relations, lipid content, and nitrogen content between channel- and river-hatched sockeye migrants. It is suggested, however, that these differences are due to the fact that the timing of the peaks of migration of these two groups of fish differed and that at any one time channel fry were physiologically different from river fry. Growth of the chum salmon in sea water and the sockeye in the lake was exponential and the slope of the weight-length relations, $W = aL^b$, was approximately 3.25. During this growth period although total weight, moisture, solids, lipid, and nitrogen increased the rate of increase in moisture was less than the rates of increase in total weight or the other constituents. (Authors)

12073. Jackim, Eugene, Janice M. Hamlin, and Stephen Sonis (Federal Water Pollution Control Admn., National Marine Water Quality Lab., West Kingston, Rhode Island). 1970. EFFECTS OF METAL POISONING ON FIVE LIVER ENZYMES IN THE KILLIFISH (Fundulus heteroclitus). J. Fish. Res. Bd. Canada, 27(2): 383-390.

Activities of five liver enzymes (acid and alkaline phosphatase, catalase, xanthine oxidase, and ribonuclease) from Fundulus heteroclitus surviving exposure to 96-hr TL_m concentrations of salts of six metals (lead, copper, mercury, beryllium, cadmium, and silver) differed markedly from those of unexposed fish. Changes in enzyme activity produced by the exposures were not necessarily the same in magnitude or direction as those observed when the salts were introduced directly into the enzyme preparations. It is proposed that changes in liver enzyme activity may be useful as a kind of biochemical autopsy tool for diagnosing sublethal metal poisoning in fish. (Authors)

12074. Turner, Gary E., and Hugh R. MacCrimmon (Dept. of Zoology, Univ. of Guelph, Guelph, Ontario, Canada). 1970. REPRODUCTION AND GROWTH OF SMALLMOUTH BASS, Micropterus dolomieui, IN A PRECAMBRIAN LAKE. J. Fish. Res. Bd. Canada, 27(2): 395-400.

Nest building by smallmouth bass in Tadenac Lake, Ontario, began in early June at 15-18 C and lasted less than 1 week. Nests were constructed at 0.3-2.4 m from the leeward shore. Egg incubation lasted 4 days at 15.2-18.2 C. Post-larval fish rose off nests at 8-11 days after hatching. Schools of young fish dispersed at 19-28 days. Both sexes matured at ages IV (18.7-25.0 cm) to VI (26.4-36.6 cm). Oldest fish (41.2 cm) were age IX. Temperature and shelter in the epilimnion determined summer distribution of fish of all ages. Annual littoral harvest (1963-66) averaged 4.0 k/ha, or 1.1 fish per angling hour. (Authors)

12075. Crutchfield, James A. (Univ. of Washington, Seattle, Washington). 1966. A NOTE ON ECONOMIC ASPECTS OF FISHERY MANAGEMENT. FAO Fisheries Circular No. 27, 14 p. Publisher: FAO of the United Nations, Rome, Italy.

12076. Umminger, Bruce L. (Dept. of Biology, Yale Univ., New Haven, Conn.). 1970. EFFECTS OF TEMPERATURE ON SERUM PROTEIN COMPONENTS IN THE KILLIFISH, Fundulus heteroclitus. J. Fish. Res. Bd. Canada, 27(2): 404-409.

Electrophoretic patterns of serum proteins were studied in Fundulus heteroclitus acclimated to temperatures from 30 to -1.5 C. Microzone electrophoresis on cellulose acetate revealed eight distinct zones (seven anodal and one cathodal to the origin) at all temperatures. These zones were grouped into three larger zones (I, II, and III) for convenience in analysis. Low mobility proteins of zone III decreased in the cold to a greater degree than did high mobility proteins of zones II and I. The greater reduction in these low mobility proteins, which are comparable to human gamma globulins, might produce a less active immune response in cold-acclimated killifish. (Auth.)

12077. Odense, P. H., T. C. Leung, T. M. Allen, and E. Parker (Fish. Res. Bd. of Canada, Halifax Lab., Halifax, Nova Scotia, Canada). 1969. MULTIPLE FORMS OF LACTATE DEHYDROGENASE IN THE COD, Gadus morhua L. Biochemical Genetics 3, 317-334; Commercial Fisheries Abstracts, 23(4), Abstract 0.38, 1970.

The patterns of the isoenzymes of fish lactate dehydrogenase are characteristic of the tissue and the species of fish. In 1965, Markert and Faulhaber classified 30 species of fish on the basis of the lactate dehydrogenase isoenzyme bands found in each species. Although a two-subunit system accounts for most of the L-lactate dehydrogenase patterns found in these fishes, Hochachka (1966) and Morrison and Wright (1966) postulated the presence of additional subunits in order to account for the complex lactate dehydrogenase patterns of trout tissues. Also, genetic variants of lactate dehydrogenase subunits have been found in fish tissues. In the present paper, the authors postulate the presence of five types of subunits to explain the lactate dehydrogenase zymogram patterns of cod tissues. -- F. T. Piskur.

12078. Broenkow, William W., and Joel D. Cline (Dept. of Oceanography, Univ. of Washington, Seattle, Washington). 1969. COLORIMETRIC DETERMINATION OF DISSOLVED OXYGEN AT LOW CONCENTRATIONS. Limnology and Oceanography, 14(3): 450-454; Commercial Fisheries Abstracts, 23(4), p. 20, 1970.

The Winkler method (1888) is used almost exclusively in oceanographic work for determining dissolved oxygen, but when oxygen concentrations are less than 10 percent of the saturation value, it is imprecise. Moreover, atmospheric contamination can cause serious error, and, in addition, the method requires the use of special analytical and sampling procedures. Described here is a method for precisely measuring oxygen concentrations of between 0 and 50 µg.-atoms/liter. The authors do not offer it as a substitute for the Winkler method, although it is 10 times more precise, for it is useful only when the oxygen concentrations are low. -- L. Baldwin

12079. Vyncke, W. (Fish. Res. Sta., Ministry of Agriculture, Ostend, Belgium). 1968. NEW LABORATORY METHOD FOR EXPRESSING FISH FLUID. Lab. Pract. 17(7): 813-816; Analytical Abstracts 17(5): Item 3135, 1969; Commercial Fisheries Abstracts, 23(4), p. 20, 1970.

The author used a disk-type hand press to extract expressible fluid from cod, redfish, and herring. He then analyzed the fluid for total solids, refractive index, total volatile bases, trimethylamine, and volatile reducing substances and investigated the factors affecting the efficiency of expression. -- L. Baldwin.

12080. Cline, Joel D. (Dept. of Oceanography, Univ. of Washington, Seattle, Washington). 1969. SPECTROPHOTOMETRIC DETERMINATION OF HYDROGEN SULFIDE IN NATURAL WATERS. Limnology and Oceanography 14(3): 454-458; Commercial Fisheries Abstracts, 23(4), p. 19, 1970.

The methylene blue method of determining small concentrations of hydrogen sulfide in water has been widely used since Fischer introduced it in 1883. It is sensitive and specific for sulfide-sulfur, so it is readily adaptable for routine

analysis of sulfide-sulfur in sewage and in sea water. However, it can give erratic results. Therefore the author devised a procedure that is applicable to natural waters containing from 1 to 1,000 μg.-atoms/liter sulfide-sulfur (from 0.03 to 32 p.p.m.) and that is free of salt effects and temperature influences. It has the following advantages over the Lauth's violet procedure described by Strickland and Parsons (1968): it uses a single reagent, which contains N, N-di-methyl-p-phenylenediamine sulfate and does not require recrystallization before use; it has superior color and reagent stability at low sulfide concentrations; it is applicable to a wide range of sulfide concentrations; it is about 10 percent more sensitive; and the procedure for standardization is simpler. -- L. Baldwin

12081. Lahav, M., and S. Sarig (Field Lab. for Res. of Fish Diseases, Nir David, Israel). 1969. SENSITIVITY OF POND FISH TO COTNION (AZINPHOSMETHYL). Bamidgeh, 21(3): 67-74; Commercial Fisheries Abstracts 23(4): p. 29, 1970.

In this report of research supported by a grant from the Israeli Field-Crop Growers' Association, the authors examined the fish-poisoning potential of pesticides applied to field crops adjoining fish ponds. To find a way to limit the damage caused by the pesticides, they determined the lethal dosages as well as the concentrations that would not cause damage to the fish affected -- carp, mullet, and tilapia. Parathion and cotnion as supplied by the Field-Crop Growers' Association were dissolved in xylene at concentrations (w/v of active material) of 50 and 20 percent, respectively. Cotnion was found to be from five to ten times more poisonous to the fish than parathion is. In 96 hours, 0.2 p.p.m. cotnion killed all the carp, 0.04 p.p.m. dilled all the tilapia, and 0.008 p.p.m. killed all the mullet. Carp were killed by 0.12 p.p.m. after 10 days' exposure but survived a concentration of 0.1 p.p.m. The highest nonlethal dosages for 96 hours' exposure were 0.1 p.p.m. for carp, 0.008 for tilapia, and 0.004 for mullet. The salinity of the water did not affect the mullet's sensitivity to cotnion. Continual periodic application of sublethal amounts (single exposure for 96 hours) down to 0.02 p.p.m. killed the carp. In 96 hours, 1 p.p.m. parathion killed all the carp, 0.5 p.p.m. killed all the tilapia, and 0.125 p.p.m. killed all the mullet. The highest nonlethal dosage of parathion was 0.5 p.p.m. for carp, 0.25 for tilapia, and 0.1 for mullet. -- L. Baldwin

12082. Groves, Alan B., Gerald B. Collins, and Parker S. Trefethen (U. S. Bur. of Commercial Fisheries, Biological Lab., Seattle, Washington). 1968. ROLES OF OLFACTION AND VISION IN CHOICE OF SPAWNING SITE BY HOMING ADULT CHINOOK SALMON (Oncorhynchus tshawytscha). J. Fish. Res. Bd. Canada, 25(5): 867-876.

An experiment was conducted to examine the roles of olfaction and vision in directing the choice of spawning site by homing adult chinook salmon (Oncorhynchus tshawytscha) on the lower Columbia River. Male fish that voluntarily entered the Spring Creek National Fish Hatchery were treated to occlude their olfactory or visual senses or both. Treated and untreated (control) fish were released upstream and downstream in the river, more than 19 km from the hatchery. Effects were assessed by analyzing returns to the hatchery and to other points. Of 866 fish released, 348 or 40% were recovered; about half of them, or 176 returned to Spring Creek. Three percent of the olfactory occluded, 23% of the visually occluded, and 46% of the control fish returned to Spring Creek. Of the fish recovered elsewhere, 77% were recovered at hatcheries and spawn-taking sites along the lower Columbia; 23% were recovered from sources unrelated to spawn taking. Olfaction appeared to be the key sense that directed the return of these fish to Spring Creek; vision was held to be less important. Olfactory occlusion also reduced the recoveries at other spawn-taking sites, where blinded fish were recovered in appreciable numbers. Recovery of the control fish, especially the smaller ones, at other spawn-taking sites was associated with advancing sexual maturity. (Authors)

12083. Tabb, Durbin C., David L. Dubrow, and Raymond B. Manning (Inst. of Marine Science, Univ. of Miami, Miami, Florida). 1962. THE ECOLOGY OF NORTHERN FLORIDA BAY AND ADJACENT ESTUARIES. State of Florida Board of Conservation Technical Series No. 39.

12084. Lantz, Kenneth E. 1970. AN ECOLOGICAL SURVEY OF FACTORS AFFECTING FISH PRODUCTION IN A LOUISIANA BACKWATER AREA AND RIVER. Louisiana Wild Life and Fisheries Commission, A Dingell-Johnson Project, Fisheries Bull. No. 5., 60 p.

This completion report covers the six jobs of Dingell-Johnson Project F-9-R conducted in the Amite River and Spring Bayou Backwater Area of Louisisna from July 1, 1960 through June 30, 1964. The objectives of this project were: (1) to establish what habitats are high, average or low in production of fish food organisms, (2) to determine what cycles occur in the kinds and abundance of plankton and bottom fauna and (3) to correlate these cyclic occurrences with variance in fish production in the two study areas. Monthly measurements of physio-chemical features and plankton production in the river and backwater area are discussed. Seasonal production of bottom fauna and annual production of fish are presented along with data indicating seasonal utilization of available benthos and plankton by fish in each study area. Dissolved oxygen, free carbon dioxide, pH and total phosphate monthly values between upstream and downstream regions of the Amite River were correlated with monthly stream flow changes. Increases in alkalinity and total phosphate values in the Spring Bayou Area were associated with late spring backwater flooding from the Red River. Reduction in the annual occurrence and degree of backwater flooding since 1954 has caused reduced spring turbidities and water fluctuations in the Spring Bayou Area, resulting in the establishment and spread of submerged vegetation throughout the area. Seasonal bottom fauna counts and weights were maximal in winter and minimal in late spring and early summer in both study areas. Trends in the Amite River bottom fauna correlated with changes in seasonal stream flows. Summer fish population samples from the Spring Bayou Area indicate this series of shallow lakes is supporting one of Louisiana's highest standing crop of total and available size fish. The desirable predator-prey ratios of fish found in this area are outstanding, although there has been a reduced occurrence of backwater flooding during the past ten years. Low standing crop values and poor predator-prey ratios in the Amite River are similar to values reported in infertile lotic areas of western Louisiana. Seasonal utilization of fish foods indicate Chironomidae and Chaoborinae were major food items in summer diets of bluegill, redear sunfish and black crappie in the Spring Bayou Area. There was a seasonal shift in feeding to non-benthic Amphipoda in winter collections of bluegill and crappie. Stomach samples from the Amite River were too few in number to indicate any seasonal trends in feeding. (Auth.)

12085. Buss, Keen, Jack Miller and Dixon Waite (Pennsylvania Fish Commission, Pennsylvania). 1968. A MODIFICATION OF CONCRETE REARING TANKS TO IMPROVE DISTRIBUTION AND GROWTH OF FINGERLING TROUT. Innovations for Fish Culturists No. 1, Benner Spring Research Station, Pennsylvania.

One disadvantage of the tank system is that fish have a tendency to crowd into a very limited area at the water inlet, usually a spigot instead of utilizing the space inherent in the design of the system. To disperse the fish, a 2 inch perforated pipe extending from one end to the other was installed. Three rows of 1/8 inch holes were drilled 6 inches apart on the row. The holes were staggered in such a fashion that there was a hole every three inches. The perforations were turned down toward the bottom of the tank causing the flow to course horizontally across the bottom of the tank. In this environment, fingerlings start quicker and grow faster than in conventional troughs and tanks. (Authors)

12086. Miller, Jack, Dixon Waite, and Keen Buss (Pennsylvania Fish Commission, Pennsylvania). 1968. FISH FOOD DISPENSER FOR TANKS AND TROUGHS. Innovations for Fish Culturists No. 1, Benner Spring Research Station, Pennsylvania.

A fish food dispenser for tanks or troughs can easily be constructed in shops which have facilities for welding. Frequent feeding with good dispersion is possible with this feeder. Food dispersed from this unit has a tendency to float longer than hand-scattered food. Feeding at the intervals which small trout require is easily obtained with a minimum of labor. Upkeep is negligible. (Authors)

12087. Buss, Keen, Dixon Waite, and Ray McCreary (Pennsylvania Fish Commission, Pennsylvania). 1968. FIFTY-FIVE GALLON STEEL DRUMS FOR TROUT EGG INCUBATION AND FINGERLING REARING. Innovations for Fish Culturists No. 1, Benner Spring Research Station, Pennsylvania.

One of the simplest forms of trout culture can be practiced in 55 gallon drums. Hatcheries which have a plentiful supply of water can set the drums up with individual inlets and outlets. This system has the advantage of minimizing the spreading of disease since the water does not flow through more than one drum. These units are also excellent for experimental work of all types, such as nutritional studies, where there is a need for replication in identical environments. A disadvantage of this system is the inability to greatly vary the flow. Where the flow is limited, the barrels can be set up in series in a step down fashion. Trout eggs can be incubated easily in these drums, preferably in only one drum in each series. The fish are fed from the top with dry feeds, and even though the current is coming up, the dry feed, if thrown in forcefully, will slowly sink. It is not necessary to clean the barrels daily and when labor is scarce, they need not be cleaned more than every month. These 55 gallon drums afford a system of incubating eggs, and starting fry and fingerlings with an exceptionally small amount of labor. (Authors)

12088. Nakagawa, Heisuke, and Yasuhiko Tsuchiya. 1969. STUDIES ON RAINBOW TROUT EGG (Salmo gairdnerii irideus). I. ELECTROPHORETIC ANALYSES OF EGG PROTEIN. J. Fac. Fish. Hiroshima, 8(2): 77-84.

The nature of protein in the immature egg yolk of rainbow trout was investigated. There are three components in the proportion of 84.0, 11.6, and 4.4 per cent in the yolk. Among these three components the principal one, component I, was a kind of lipoprotein. It contained 11.9 per cent nitrogen, 0.5 per cent phosphorus, a little carbohydrate, and 22.8 per cent lipid of which some 50 per cent was phospholipid. It is noteworthy that this lipoprotein-like substance was deficient in carotenoid pigment. Component II was an unidentified protein composed of 12.7 per cent nitrogen and less than 0.1 per cent phosphorus. Component III was a phosphoprotein soluble in water. It contained 8.2 per cent phosphorus and 14.3 per cent nitrogen. (Authors)

12089. Nagayama, Fumio, and Yuji Saito (Tokyo Univ. of Fisheries, Konan 4, Minato-ku, Tokyo, Japan). 1969. STUDIES ON β-GALACTOSIDASE OF THE RAINBOW TROUT LIVER – II. EFFECTS OF SEVERAL COMPOUNDS ON THE ENZYME. Bull. Jap. Soc. sci. Fish., 35(9): 933-939.

The effects of sugars, lactones, heavy metals, and salts on the β-galactosidase isolated from the liver of rainbow trout were investigated. The β-galactosidase I and II were activated by glucose, sucrose, gluconolactone, and glucarolactone. Galactose inhibited both isozymes competitively, while galactonalactone inhibited enzyme I competitively, and enzyme II noncompetitively. Lactose, a β-galactoside, was not only resistant but inhibitory to β-galactosidase I and II of the rainbow trout. Heavy metal ions inhibited both isozymes noncompetitively. The metal inhibition was recovered by the addition of cysteine, but not by EDTA. The β-galactosidase I and II of the rainbow trout were found to be activated by Cl^-, while the bacterial β-galactosidase was reported to be inhibited by Cl^- and activated by Na^+. Both the substrate affinity and $V_{max.}$ of enzyme I were increased by NaCl, which caused only the elevation of the substrate affinity of enzyme II. (Authors)

12090. White, Ray J., and Robert L. Hunt. 1969. REGULARLY OCCURRING FLUCTUATIONS IN YEAR-CLASS STRENGTH OF TWO BROOK TROUT POPULATIONS. Wisconsin Academy of Sciences, Arts and Letters, Vol. 57, pp. 135-153.

During a 12-year period (1953-64) year class strength of wild brook trout (Salvelinus fontinalis) fluctuated rhythmically in two central Wisconsin streams, Lawrence Creek (Adams and Marquette Counties) and Big Roche-a-Cri Creek (Adams and Waushara Counties). The nature of these rhythmic year class fluctuations and some possible reasons for their regularity are examined. (Authors)

12091. Schoettger, Richard A. (Bur. of Sport Fisheries and Wildlife, Fish Control Lab., La Crosse, Wisconsin). 1970. INVESTIGATIONS IN FISH CONTROL 35. TOXICOLOGY OF THIODAN IN SEVERAL FISH AND AQUATIC INVERTEBRATES. Bur. of Sport Fisheries and Wildlife, Investigations in Fish Control 35, 31 p.

This investigation provides toxicological data on Thiodan to meet published criteria for evaluating chemicals for fish control. Thiodan, a chlorinated hydrocarbon insecticide, was tested against rainbow trout and their fertilized eggs, western white suckers, Daphnia magna, and damselfly naiads. The median tolerance limits for trout and suckers ranged between 0.3 and 8.1 ppb and the fish were at least seven times more susceptible than the invertebrates. Toxicity was influenced by temperature, length of exposure, and alkaline pH. Exposures for up to 2 hours to 50 ppm of Thiodan were not toxic to fertilized trout eggs. The deposition and metabolism of Thiodan residues in western white suckers, northern creek chubs, and goldfish were traced with the aid of carbon-14 labeled Thiodan, and chemical analyses of Thiodan in tissues. Residues occurred in the skin and muscles of fish exposed to acute and to multiple subacute concentrations. The death of fish which were poisoned subacutely was correlated with size and the lipid content of muscle. The residues in the various tissues seemed to be associated with the method of treatment. A water-soluble metabolite of Thiodan in the bile of treated fish appeared to be a glucosiduronic acid conjugate of Thiodan alcohol. A possible metabolic pathway for Thiodan degradation is discussed. Thiodan appears to have little value as a selective piscicide against rough fishes such as carp or suckers, but under certain conditions it may be a good general fish toxicant. (Auth.)

12092. Hassler, Thomas J. (Bur. of Sport Fisheries and Wildlife, North Central Reservoir Investigations, Pierre, South Dakota). 1969. BIOLOGY OF THE NORTHERN PIKE IN OAHE RESERVOIR, 1959 THROUGH 1965. Bur. of Sport Fisheries and Wildlife Technical Paper No. 29, pp. 1-13.

Variations in length, weight, and maturity of northern pike in Oahe Reservoir were associated with sex and year class. Females were larger and more numerous than males. Catches were dominated by the 1959 and 1962 year classes; the 1964 year class was missing. Annulus formation began in April and was completed by July. Some males formed an annulus before spawning; females formed one after spawning. Males generally matured at age I and females at age II. Since impoundment, large year classes have been associated with a rise in water level above previous high levels in spring and continuation of the higher level through early summer. (Auth.)

12093. Elrod, Joseph H., and Thomas J. Hassler (Bur. of Sport Fisheries and Wildlife, North Central Reservoir Investigations, Pierre, South Dakota). 1969. ESTIMATES OF SOME VITAL STATISTICS OF NORTHERN PIKE, WALLEYE, AND SAUGER POPULATIONS IN LAKE SHARPE, SOUTH DAKOTA. Bur. of Sport Fisheries and Wildlife Technical Paper No. 30, pp. 1-17.

Catch-effort data derived from gill net samples were used to estimate relative abundance, age composition, sex ratio, growth rate, survival rate, and relative year-class strength of northern pike, walleye, and sauger populations in Lake Sharpe, Missouri River, S. D., during the first 3 years of impoundment (1964-66). Catches were generally highest in Oahe Dam tailwaters. Females were more numerous and larger at most ages than males. A large 1964 year class of northern pike and walleye dominated catches of these species through 1966. Survival rate of the 1964 year class of northern pike declined with age. Survival of pre-1964 year classes of walleye and sauger was higher from 1965 to 1966 than from 1964 to 1965. Relative abundance of northern pike declined during the period considered. (Authors)

12094. Buss, Keen, Jack Miller, and Kenneth Corl (Pennsylvania Fish Commission). 1968. NEW DESIGN OF PLASTIC JARS FOR FISH EGG INCUBATION AND FOR HOLDING FINGERLING TROUT. Innovations for Fish Culturists No. 1, Benner Spring Research Station, Pennsylvania.

12095. Hughes, G. M., and J. L. Roberts (Dept. of Zoology, Bristol Univ., England). 1970. A STUDY OF THE EFFECT OF TEMPERATURE CHANGES ON THE RESPIRATORY PUMPS OF THE RAINBOW TROUT. J. exp. Biol., 52(1): 177-192.

Trout subjected to changes in water temperature (1°/3 min.) between 15° and 30°C. showed a number of responses in their ventilation and cardiac mechanisms. Ventilation rate increased slowly over the range 15°-21°C., but increased more rapidly at higher temperatures (21°-26°, Q_{10} = 2·34; 26°-28°, Q_{10} = 4·02). Cardiac frequency fell markedly about 26°C., and this bradycardia suggests that above this temperature the ventilation mechanism is inadequate to maintain a sufficient level of blood P_O. Possibly this insufficiency results from a failure of the pumping mechanism to increase or even maintain a large minute volume at high frequencies. Pressure recordings indicate those parts of the ventilatory mechanism which are mainly involved in these responses. Increases in the buccal, opercular, and mean differential pressures indicated that the volume of water pumped across the gills increased during the initial stages of warming and only at higher temperatures did frequency become involved. Variability in the balance between the buccal and opercular pumps among individual trout becomes even more apparent under temperature stress, as in some cases the opercular pumps seem to be mainly involved in the increased ventilation but not always. The action of the buccal and opercular pumps seems well co-ordinated, especially at intermediate temperatures, but serious uncouplings occur at higher temperatures as indicated by the shape of the pressure waveforms and especially the appearance of double reversals in the differential pressure curve. The relationship between cardiac and ventilatory cycles was not studied in great detail, but there were certainly indications of changes in coupling. However, it was clear that the two rhythms do not always become phase-locked even at high temperatures. The effect of changing temperature on the physical environment of the fish is discussed in relation to these observed responses. (Authors summ.)

12096. Kubota, Saburoh S. 1967. PATHOLOGICAL STUDIES ON THE REGRESSIVE PROCESSES OF CARDIAC MUSCLE FOUND IN X-DISEASE, AND ADDITIONAL DISCUSSION ON THE ETIOLOGY OF THIS DISEASE. J. Fac. Fish. Univ. Mie, 7(2): 199-209. (In Japanese with English resumé).

This study concerns five cases of X-disease found in the hearts of the rainbow trout, Salmo gairdneri, in the culture ponds at the Kamori Trout Hatcheries. Pathogenesis of the cardiac muscle was characterized by hyaline degeneration, deposition of hemofuscin, appearance of a spheroidal degeneration body as a substrate of hemofuscin, albuminosis and the regression of nuclei. All of these symptoms indicated that the disease involved total infarct of the myocardium caused by malignant anemia. A comparison of these regressive processes was made with an anemic infarct in the human heart. The pathological changes observable in the fish and man have something in common. The spheroidal degeneration body of the myocardium was discriminated from that of the hepatic cell by a sudanophobic property. But, their substrates were all similar from histo-chemical and morphological points of view, in so far as they contain hemo- or lipofuscin. The substrates were not in accordance with ceroide pigment by LIOSN. An additional discussion on the etiology of X-disease is also given.

12097. MacPhee, Craig, and Richard Ruelle. 1969. LETHAL EFFECTS OF 1888 CHEMICALS UPON FOUR SPECIES OF FISH FROM WESTERN NORTH AMERICA. Forest, Wildlife and Range Experiment Station Bull. No. 3, 112 p., Published by Univ. of Idaho, College of Forestry, Wildlife and Range Sciences, Moscow, Idaho.

A piscicide screening program was conducted with 1, 888 different chemicals mostly at concentrations of 10 ppm. The times at which fish lost their equilibrium and died are given for 2, 552 separate 24-hour assays. The species tested were the northern squawfish (Ptychocheilus oregonensis), chinook salmon (Oncorhynchus tshawytscha), coho salmon (Oncorhynchus kisutch), and steelhead (Salmo gairdneri). (Authors)

12098. Teshima, Shin-ichi, and Ken-ichi Kashiwada (Lab. of Fisheries Chemistry, Faculty of Fisheries, Kagoshima University, Japan). 1969. STUDIES ON THE PRODUCTION OF B-VITAMINS BY INTESTINAL BACTERIA OF FISH - IV. PRODUCTION OF NICOTINIC ACID BY INTESTINAL BACTERIA OF CARP. Mem. Fac. Fish. Kagoshima, Vol. 18, pp. 87-91. (In Japanese with English abstract).

In order to determine to what extent intestinal bacteria synthesize nicotinic acid during growth, 209 strains of bacteria were isolated from the intestinal canal of carp, and production of this vitamin by these bacteria was examined. Decrease of the nicotinic acid content in the medium was observed in 47 strains when they were cultivated in bouillon medium at 30°C for 24 hours. It was found that only a few bacteria could produce notable nicotinic acid under these conditions. All the 25 strains of bacteria which can grow in Massen's medium produced nicotinic acid to some extent. Accumulation of nicotinic acid in the medium surpassed that of bacterial body, and the acid concentration reached a maximum at about 2 days of cultivation.

12099. Fowler, Laurie G., and Joe L. Banks (Bur. of Sport Fisheries and Wildlife, Salmon-Cultural Lab., Longview, Washington). 1970. TESTS OF SUBSTITUTE INGREDIENTS AND EFFECTS OF STORAGE IN THE ABERNATHY SALMON DIET, 1968. Bur. of Sport Fisheries and Wildlife Technical Paper No. 47, 8 p.

Feeding experiments in 1968 with fall chinook salmon fingerlings (Oncorhynchus tshawytscha) indicated that storage for 11 months did not affect the nutritional quality of pellets. Peruvian anchovy meal caused deaths and a general degenerate condition, while herring and hake meals were equal to salmon meal in protein quality. Growth was not reduced when the dried skim milk portion of the diet was decreased by 75 percent provided that the protein intake was maintained by an increase in fish meal. Likewise, dried whey could be substituted for dried skim milk if the protein intake was maintained by increased levels of fish meal. Salmon oil was comparable to soybean oil in the diet but more rancid. (Authors)

12100. Cunningham, B. T. 1969. THE SIGNIFICANCE AND ROLE OF FRESHWATER FISHING. Reprint from: Fisheries and New Zealand, 180(2), 3 p., Victoria Univ. of Wellington, New Zealand.

New Zealand had no indigenous fish populations suitable for game or angling purposes in its freshwaters, so a great variety of fish were introduced and tried. Angling, today, is based upon principally acclimatized populations of brown trout, rainbow trout and quinnat salmon. Angling pressures and the quality of angling were appraised during the 1951-2 angling season, when it was found that anglers spent about 1-1/2 million hours fishing, taking 1 million fish averaging 2-1/2 lb in weight. Currently, further data on angling quality and pressure are being collected from anglers for analysis. Trout and salmon are not able to maintain themselves naturally in many New Zealand waters. The large-mouth bass was selected as a suitable game fish for dune lakes in Northland but the introduction of this fish was not approved by the Government. The development of freshwater for angling or recreational uses and also for commercial interests - to expand and diversify fisheries products principally at export - needs to be carefully balanced and reconciled through the promulgation of suitable conservation regulations. Current developments in freshwater fisheries cover both the commercial and sporting fields, and it is expected that expansion can continue to be achieved to the benefit of all users and the New Zealand economy as a whole.

12101. Cumming, Kenneth B. (Bur. of Comm. Fisheries Biological Lab., Woods Hole, Massachusetts). 1967. NATURAL HEMAGGLUTININS IN MARINE FISHES. International Comm. for the Northwest Atlantic Fisheries Research Bull. No. 4, pp. 59-66.

A large number of serological crossmatches between 33 species of marine fishes indicated that the blood of many of them contains natural agglutinins. These normal bloods are potential serological reagents for racial studies in fishery work. One example is presented to show the heterogeneity of haddock erythrocytes by using the serum of winter flounder as the differentiating agent. (Auth.)

12102. Templeman, Wilfred (Fish. Res. Bd. of Canada, Biological Station, St. John's, Newfoundland, Canada). 1967. ATLANTIC SALMON FROM THE LABRADOR SEA AND OFF WEST GREENLAND, TAKEN DURING A. T. CAMERON CRUISE, JULY - AUGUST 1965. International Comm. for the Northwest Atlantic Fisheries Research Bull. No. 4, pp. 5-40.

In 18 surface drift-net sets made from 12 July to 24 August 1965 by the A. T. Cameron, 39 Atlantic Salmon were caught; 6 were taken over oceanic depths in the Labrador Sea from 18 to 20 July; 13 were taken on the West Greenland banks, almost all over the shallower water, from 5 to 16 August; 2 were taken over deep water west of Cape Desolation on 21 August; the largest catch, 13 in one set, was made over oceanic depths west of Cape Farewell on 21 and 22 August; and 5 were taken over oceanic depths in the Labrador Sea on 22 and 23 August. A few of the salmon appeared to be travelling in pairs or in small schools of three. They were caught near the surface, 97% in the upper 8 ft (2.4 m). Sixty-one percent of the salmon had 2 years of river and the numbers with 2, 3, 4, 5, and 6 years of river life were 23, 7, 4, 2, and 2. Thirty-six of 38 salmon had 1+ sea years, two having 2+ sea years. West Greenland and Labrador Sea salmon in our small samples had river ages too low for purely Canadian random samples and too high for samples entirely from Britain and Ireland. Sex ratios were 14 M:24 F. All males were very immature but one 2+ sea-year female from the Labrador Sea on 19-20 July could possibly but not necessarily have been maturing to spawn in the same year. Salmon from the West Greenland banks had more food in their stomachs and had greater girths and weights at the same lengths than salmon from west of Cape Farewell and Cape Desolation. Of the meristic characters, vertebral counts, at least, are worth following further for possible use in locating the home areas of the West Greenland fish. Food was principally larval Arctic squid, Gonatus fabricii, in the Labrador Sea and launce with some capelin on the West Greenland banks. Secondary foods over deep water were paralepids and Greenland halibut fry. There were indications that the percentage of salmon possessing tapeworms, Eubothrium crassum, may increase with length of river life and that the presence of this parasite may be worth following for area of origin of West Greenland salmon. Data from the literature on salmon migrations in the western Atlantic and on smolt ages in North American and European rivers are reviewed. (Auth.)

12103. Servizi, J. A., R. W. Gordon, and D. W. Martens. 1969. MARINE DISPOSAL OF SEDIMENTS FROM BELLINGHAM HARBOR AS RELATED TO SOCKEYE AND PINK SALMON FISHERIES. International Pacific Salmon Fisheries Comm. Progress Report No. 23, 38 p.

A recent proposal for dredging and marine disposal of sediment from Whatcom Waterway, Bellingham was of concern to fisheries agencies since the proposed disposal area was utilized by several fish stocks, including migrating Fraser River sockeye and pink salmon. Laboratory study indicated that two types of sediment were involved. Sediment from the inner harbor consisted primarily of putrefying pulp fibers which exerted a significant oxygen demand, created substantial turbidity, and were toxic to juvenile sockeye salmon because of their hydrogen sulfide content. Hydrogen sulfide was readily dissipated from inner harbor sediment by diffused air but was not removed by exposure for a few hours to the atmosphere. Various methods of widespread dispersal to dilute the sediment appeared impractical, and it was concluded that land disposal of inner harbor sediment would be necessary to protect fish stocks. Sediment from the outer harbor was a natural silt, not containing hydrogen sulfide, but exerted an oxygen demand and created a highly turbid mixture which settled very slowly. Because dumping of this sediment at the proposed site could also prove harmful to fisheries, hydraulic dredging and local disposal adjacent to the outer harbor was recommended. (Authors)

12104. Bedford, B. C. (Fisheries Lab., Lowestoft, England). 1964. TWO MECHANICAL AIDS FOR OTOLITH READING. International Comm for the Northwest Atlantic Fisheries Research Bull. No. 1, pp. 79-81.

Mechanical devices are described for preparing quickly, an almost standard section of each otolith and for controlling the illumination of the section surface. (Auth.)

12105. Sakaguchi, Hiromi, Fumiya Takeda, and Katsuyoshi Tange (Fish. Exp. St., Hyogo Pref., Nakasaki-machi, Akashi, Japan). 1969. STUDIES ON VITAMIN REQUIREMENTS BY YELLOWTAIL - I. VITAMIN B_6 AND VITAMIN C DEFICIENCY SYMPTOMS. Bull. Jap. Soc. sci. Fish., 35(12): 1201-1206. (In Japanese with English abstract).

Although vitamin requirements by fresh-water fish have been studied extensively by many workers, only few works have been reported on marine fishes. We studied Vitamin B_6 or C deficiency syndromes of the yellowtail Seriola quinqueradiata TEMMINCK et SCHLEGEL by feeding the fish with diets composed of white fish meal, gluten, glucose, cod liver oil, vitamin-mixture without vitamin B_6 or C, and mineral-mixture. Both vitamin B_6 and C deficiency symptoms appeared after about 40 days. Characteristics of B_6 avitaminosis of the yellowtail were anorexia, retarded growth, nervous disorder, high mortality, injury at mouth and rostrum regions, exophthalmia and scoliosis. The fish fed with a diet lacking vitamin C showed loss of activity and appetite, retarded growth, change of body color, poor growth of operculum, scoliosis, amputation of strait, and hemorrhage in the latero-dorsal region. Fat content in the liver decreased in both B_6 and C deficient fish. Serum protein of the yellowtail was separated into four fractions by electrophoresis on cellulose acetate membrane. In the serum of the fish fed with vitamin B_6 or C deficient diet, fraction I decreased but fractions III and IV increased.

12106. Nagayama, Fumio, and Yuji Saito (Tokyo Univ. of Fisheries, Konan, 4, Minato-ku, Tokyo, Japan). 1969. STUDIES ON β-GALACTOSIDASE OF THE RAINBOW TROUT LIVER - I. PURIFICATION AND SOME PROPERTIES OF THE ENZYME. Bull. Jap. Soc. sci. Fish., 35(9): 927-932. (In Japanese with English abstract).

In an earlier paper dealing with the distribution of glycosidases in fish, it was shown that β-galactosidase activity is found in every fish tissue. In this paper, the purification procedure of β-galactosidase from the rainbow trout liver and some properties of the enzyme are described. The β-galactosidase was extracted from the liver of rainbow trout averaging 150 g in weight. Two isozymes of β-galactosidase were isolated by Sephadex column chromatography. The molecular weights of the isozymes estimated by the gel filtration were 340,000 for β-galactosidase I, and 170,000 for β-galactosidase II. The optimal pH range for both isozymes was 3.8-4.2, and the stable pH range was 4.5-6.5. The activation energy calculated from the ARRHENIUS plots was about 13,000 cal./mole for both isozymes. The thermostability of enzyme I was prevailed over that of enzyme II. There was no extreme difference between the K_m values of o- and p-nitrophenyl-β-D-galactoside for both isozymes.

12107. Nagayama, Fumio, and Yuji Saito (Tokyo Univ. of Fish., Konan 4, Minatoku, Tokyo, Japan). 1969. STUDIES OF β-GALACTOSIDASE OF THE RAINBOW TROUT LIVER - III. ENZYME ACTIVITY AND ISOZYME PATTERN OF THE YEARLING FED WITH HIGH CARBOHYDRATE FEEDS. Bull. Jap. Soc. sci. Fish., 35(10): 1017-1020. (In Japanese with English abstract).

The activities of β-galactosidase and lactase, and the pattern of β-galactosidase isozymes were investigated to see the effect of dietary lactose and starch on the enzyme of the rainbow trout. The lactase activity of fish tissue was increased by high carbohydrate feeds, especially by the high lactose feed which was reported to cause the elevation of lactase activity in the calf intestine. The β-galactosidase activity in the liver and kidney was somewhat decreased by the high carbohydrate feeds, although the β-galactosidase of E. coli was known to be induced by lactose in the medium. These results may be evidence for the concept that animal β-galactosidase (o-NPGa-ase) is not identical with lactase. Three isozymes of β-galactosidase (I, III, and IV) were isolated by a Sephadex G-200 column from all tissues of the rainbow trout yearling, but isozyme II, being found in the 2-year fish, was not detected. The pattern of the isozyme seemed to be tissue specific, and not influenced by the dietary composition. The molecular weights of the isozymes were the multiples of 57,000: x6 (I), x3 (II), x2 (III), and x1 (IV). The lactase activity was not recovered from a Sephadex G-200 column.

12108. Fahlén, Göran (Zool. Inst., Lund, Sweden). 1968. THE GAS BLADDER AS A HYDROSTATIC ORGAN IN Thymallus thymallus L., Osmerus eperlanus L. AND Mallotus villosus Müll. FiskDir. Skr. Ser. HavUnders., 14(4): 199-228.

The gas bladder of Thymallus thymallus is investigated concerning topography, vascularization, histology and histochemistry. Simple micro-retia mirabilia are found, forming a counter-current vascular system of probably very low exchange capacity. The epithelium, lining the lumen, is probably one of very low activity. If a secretion of gases into the bladder occurs, it is probably very slow. The gas bladder of Osmerus eperlanus is investigated as described above. The blood vessels are not arranged as a counter-current system, though capillaries reach the base of the epithelium. The epithelium, which is also EM investigated, contains apically considerable amounts of mucopolysaccharides and glycogen. A secretion, directly to the lumen, of gases or of a matter which can be transformed into gases, is proposed. The gas bladder of Mallotus villosus also is investigated, low power electron micrographs and analyses of the gaseous content of the bladder were made after administration of pilocarpine, dibenzyline and yohimbine. No counter-current vascular system is present but capillaries reach the base of epithelium. The epithelial cells contain and probably secrete polysaccharides (though not glycogen) directly to the lumen. The gas is composed of 0 - 2% carbon dioxide, 0 - 18% oxygen and 80 - 100% inert gases. The administration of drugs did not in any case increase the percentage of oxygen or carbon dioxide, compared with the control animals. It is proposed that no gas secretion occurs. The muscle layer of the gas bladder is in all the three species continuous with the muscularis externa of the oesophagus. This argues for a neutral terminology concerning the layers of the gas bladder wall. A muscular sphincter is morphologically documented at the debouch of the pneumatic duct into the esophagus. (Auth. summ.)

12109. Dragesund, Olav, and Steinar Olsen (Fiskeridirektoratets Havforskningsinstitutt, Bergen, Norway). 1965. ON THE POSSIBILITY OF ESTIMATING YEAR-CLASS STRENGTH BY MEASURING ECHO-ABUNDANCE OF O-GROUP FISH. FiskDir. Skr. Ser. HavUnders., 13(8): 48-62.

The possibility of estimating the distribution and abundance of O-group fish by a combination of echo surveying and fishing experiments with pelagic trawl and purse seine is discussed. The existence of scattering layers, their origin, and the identification of sound scatterers are discussed with special reference to observations made in recent years off northern Norway and in the Barents Sea. The scattering layers observed in late summer and autumn in this area consist mainly of O-group fish of which herring, cod and haddock are most important. The transport of the larvae from the spawning places in relation to the current systems is described. The observations indicate that during August to October fish fry are abundant in the surface layers of the north and east going currents, and by the end of autumn the fry are aggregated along the frontiers between the cold and warm water masses covering the area from Spitsbergen to Bear Island and further to the east and south over the central and south-eastern parts of the Barents Sea. The relation between echo signals received from scattering agents distributed at a constant depth and the amount of scatterers is discussed, as well as the effect of variations in depth distribution. Special attention is paid to the signal strength received from targets uniformly distributed in a layer or school of wide horizontal distribution. The needs for theoretical as well as empirical studies of the relationship between the amount of echo signals received and the abundance of sound scatterers are stressed. The first results of charting the echo-abundance distribution are presented. For this purpose an electronic echo-integrator was developed to measure exactly the signal voltages received. Some preliminary data on the relationship between echo-abundance and the catch of fish fry with purse seine are also given. (Authors summ.)

12110. Sundnes, Gunnar, and Michael E. U. Taylor (Fiskeridirektoratets Havforskningsinstitutt, Bergen, Norway). 1964. INLAND TRANSPORT OF LIVE COD. FiskDir. Skr. Ser. HavUnders., 13(7): 70-75.

Inland transport of live cod is a far cheaper method than wellboat transport.

On the other hand the physiological stress on the fish is much higher and it can by no means be compared with wellboat transport in this field. The primary limitation on land transport was the time taken for the pH to change, but this drawback has now been partly overcome by using a borate buffer with a cost of less than 10 Kr. (or £ 0-10-0) per metric ton of live cod.

12111. Boyar, H. C. (Bur. of Comm. Fisheries, Biological Lab., W. Boothbay Harbor, Maine). 1968. AGE, LENGTH, AND GONADAL STAGES OF HERRING FROM GEORGES BANK AND THE GULF OF MAINE. International Comm. for the Northwest Atlantic Fisheries Research Bull. No. 5, pp. 49-61.

Age, length, and gonadal stages of adult herring, Clupea harengus harengus L., were determined from samples collected in 1960-65 from Georges Bank and the Gulf of Maine. Age-groups IV and V were the most abundant ages in the samples. The 1960 year-class dominated the samples from Georges Bank in 1963-65, and the samples from the Gulf of Maine in 1964-65. This year-class was the most abundant during the period of study. The 1959 year-class was extremely weak on Georges Bank, but was well represented in the Gulf of Maine. The mean lengths of the age-groups IV and V from the 1960 year-class were generally less than those from other year-classes; the slow growth and the apparent high abundance suggest that growth is density-dependent. Differences in the peak of spawning and spawning seasons among the areas were small. (Auth.)

12112. Templeman, Wilfred (Fish. Res. Bd. of Canada, Biological Station, St. John's, Newfoundland, Canada). 1968. DISTRIBUTION AND CHARACTERISTICS OF ATLANTIC SALMON OVER OCEANIC DEPTHS AND ON THE BANK AND SHELF SLOPE AREAS OFF NEWFOUNDLAND, MARCH - MAY, 1966. International Comm. for the Northwest Atlantic Fisheries Research Bull. No. 5, pp. 62-85.

Between 21 March and 1 May 1966, 45 Atlantic salmon were caught in eight surface drift-net night sets east and southeast of the Newfoundland area over depths greater than 1, 800 m. Some salmon were caught in all sets with surface temperatures between 3.7° and 6.1°C but none in a set on the eastern border of the area with a surface temperature of 9.2°C. The salmon were all captured in the upper 1.5 m of the nets. Eighty-four percent of the salmon were 2-sea-year fish and 4% had spawned previously. River life was mainly 2-4 years. Gutted weights were 89.7% of round weights. In a comparison with salmon taken by the author in the Labrador Sea-West Greenland in July-August 1965 no distinct differences were noted in body proportions, and of the meristic characters only gill rakers and pectoral fin-ray numbers were significantly different. There were also some differences in parasitic infestations. Food was 95% fish, the main diet being the paralepid, Paralepis coregonoides and lantern fish, especially Notoscopelus. There was less food in the stomachs than in the Labrador Sea-West Greenland salmon during July-August 1965 and much less than in salmon from the West Greenland banks in August 1965. (Auth.)

12113. Anthony, Vaughn C., and H. C. Boyar (Bur. of Comm. Fisheries, Biological Lab., Boothbay Harbor, Maine). 1968. COMPARISON OF MERISTIC CHARACTERS OF ADULT ATLANTIC HERRING FROM THE GULF OF MAINE AND ADJACENT WATERS. International Comm. for the Northwest Atlantic Fisheries Research Bull. No. 5, pp. 91-98.

Counts of vertebrae and of rays of the right pectoral, dorsal, and anal fins were examined from 5, 829 Atlantic herring of the 1958 and 1960 year-classes collected in 1962-65 from areas of Cape Cod, Western Maine, Eastern Maine, Southern Nova Scotia, and Georges Bank. Meristic counts were not significantly different between sexes. Differences in meristic counts among years of sampling were significant, indicating a change in the distribution of herring for a particular year for a given area. Counts of vertebrae and rays of the right pectoral fin suggested that two complexes of herring existed: a Georges Bank - Cape Cod complex which was significantly different from a Maine - Nova Scotia complex. The magnitude of differences among areas in the mean meristic counts for herring of the 1958 year-class was greater than for fish of the 1960 year-class. (Authors)

12114. Colton, John B., Jr. (Bur. of Comm. Fisheries Biological Lab., Woods Hole, Massachusetts). 1968. A COMPARISON OF CURRENT AND LONG-TERM TEMPERATURES OF CONTINENTAL SHELF WATERS, NOVA SCOTIA TO LONG ISLAND. International Comm. for the Northwest Atlantic Fisheries Research Bull. No. 5, pp. 110-129.

Offshore temperature conditions during December 1964 and 1965, March 1953, 1965, and 1966, and May-June and September 1965 and 1966 are compared with 1940-59 mean values for these months. Charts showing the distribution of temperature at the surface, 20 m, 50 m, and 100 m, and of temperature anomalies at the surface, 20 m, and 50 m are presented. At most locations and depths the 1964-66 temperatures were appreciably colder than the 1940-59 mean values. The magnitude of the negative anomalies tended to be greatest in areas off the edge of the Continental Shelf. Temperatures in March 1953 were warmer than the 1940-59 mean values. These trends paralleled trends at coastal stations as exemplified by Boothbay Harbor, Maine temperatures. The reliability of the use of coastal temperatures for indexing offshore conditions, the possible biological effects of warming and cooling trends, and the causes of these trends are discussed. (Auth.)

12115. Truskanov, M. D., and M. N. Scherbino (All-Union Research Inst. of Marine Fisheries and Oceanography (VNIRO), Moscow, USSR). 1966. METHODS OF DIRECT CALCULATION OF FISH CONCENTRATIONS BY MEANS OF HYDROACOUSTIC APPARATUS. International Comm. for the Northwest Atlantic Fisheries Research Bull. No. 3, pp. 70-80.

The possibilities and results of application of a method of direct calculation of the number of commercial fish by means of hydroacoustic apparatuses are presented. The method is considered in the following sequence: determination of parameters of hydrolocators, direct hydroacoustic survey of the commercial area, treatment of echograms, determination of the volume and of the density of fish concentrations, and analysis of errors. Results of conducting such echometric surveys in different areas of the Barents and Norwegian Seas and recommendations for their use in different areas of the West and Northwest Atlantic are given. Use of this method of calculating numbers of fish in commercial fish concentrations in fisheries investigations would allow more precise long- and short-term forecasts of the state of commercial stocks. (Authors)

12116. Tusa, Ivan (Dept. of Hydrobiology, Institute of Zoology, Faculty of Natural History, J. E. Purkyne Univ., Brno, Czechoslovakia). 1969. ON THE FEEDING BIOLOGY OF THE BROWN TROUT (Salmo trutta m. fario L.) IN THE COURSE OF DAY AND NIGHT. Zoologicke Listy, 18(3): 275-284.

In May and September, 1966, the author made qualitative and quantitative analyses of the contents of the digestive tract of brown trout caught in the same section of Loucka Creek, viz. four times during 24 hours. The degree of fullness of the digestive tract was highest in the afternoon (2:00 - 4:00 p.m.) in May and September when the water temperature in either case also was the highest (May: 17.0°C; September: 11.0°C). The lowest degree of fullness of the digestive tract corresponds to the lowest temperature measured only in September (in the early morning, 7:00 a.m.), whereas in May the lowest degree of fullness was ascertained at about midday at a water temperature of 15°C, while the lowest water temperature was found early in the morning (10.0°C at 6:00 a.m.). The difference between the degrees of fullness of the digestive tract in brown trout in the evening and in the early morning was relatively small. The composition of food consumed by the brown trout, caught in May (except for the morning fishings) as well as in September, is characterized by the presence of both aquatic and airborne organisms. A considerable abundance of airborne organisms in the food of the brown trout, coming from the morning September fishings, shows that, in contrast to similar fishings in May and with regard to the different drift composition in May and in September, the airborne organisms may form a significant part of the food even during the night. The occurrence of aquatic organisms in the drift was comparatively more constant (2.5-4.0 ind. per hour) than that of airborne organisms (0.5-7.0 ind. per hour). In May and September, the highest occurrence of airborne organisms was in the

evening (8:00 - 11:00 p.m.), the lowest at night (1:00 - 7:00 a.m.). In May, the occurrence of aquatic organisms, as examined in the course of 24 hours, was approximately the same; in September it reached its maximum in the evening, its minimum in the morning (9:00 - 12:00 a.m.). The occurrence of individual groups of organisms in the drift did not correspond for the most part to their occurrence in the food. (Auth.)

12117. Beyerle, George B. 1970. A STUDY OF TWO NORTHERN PIKE-BLUEGILL POPULATIONS. Michigan Dept. of Natural Resources Research and Development Report No. 194; Institute for Fisheries Research Report No. 1762.

Northern pike and bluegill populations were established and maintained for 3 years in two small lakes closed to fishing. Growth of pike was slightly less than the average for pike in the state of Michigan; growth of bluegills ranged from 3.6 to 7.4 cm (1.4 to 2.9 inches) below state average. High densities of pike did not control an abundance of bluegills. Survival of pike from the initial stocking was extremely high (44-60%), whereas survival from subsequent plantings was low (0.8-9.2%). (Auth.)

12118. Broadhead, Gordon C. (The Marine Lab., Univ. of Miami, Florida). 1958. GROWTH OF THE BLACK MULLET (Mugil cephalus L.) IN WEST AND NORTHWEST FLORIDA. Florida Bd. of Conservation Technical Series No. 25, 31 p.

Juvenile mullet collected by a small mesh cast net were considerably smaller at Pensacola and Apalachicola than at Cedar Keys. Samples from the commercial catches at Pensacola, Apalachicola, Cedar Keys and Homosassa contained at most two main age groups. In the Pensacola and Apalachicola samples these age groups could be traced throughout most of the year. Net selectivity may have resulted in the sampling of the faster growing fish in the population. For this reason, growth rates in the samples analysed may be more rapid than that of the population. Tagged fish grew most rapidly during the spring and summer months. The Petersen tag used on the mullet appeared to have a detrimental effect on the growth rate of the fish, at least during the period immediately after tagging. One annulus per year was formed on the scales during the fall and winter period. This annulus could be identified and used in age and growth determinations. The scales of recaptured tagged mullet were used to confirm the scale method. The growth rates calculated by the scale method agreed substantially with the results obtained by the length frequency analysis of both the juvenile and adult population. Growth rates were slower in the northwest sections of the state than in the western sections. Mullet at Cedar Keys and Homosassa reached, after two years, a length equal to that of fish at Pensacola and Apalachicola after three years. The growth rate of the female mullet appeared to be slightly more rapid than the growth rate for the males. Black mullet mature at the end of their third year of life in all areas studied. The more extensive feeding grounds for the mullet in the southern areas may be responsible for the more rapid growth rates in these areas. The temperature differences between the northwest sections and the southern sections were not great, but could have influenced the growth rates. (Auth. summ.)

12119. Beaumariage, Dale S., and Arthur C. Wittlich (Florida Bd. of Conservation, Marine Lab., Maritime Base, St. Petersburg, Florida). 1966. RETURNS FROM THE 1964 SCHLITZ TAGGING PROGRAM. Florida Bd. of Conservation Technical Series No. 47, 50 p.

A total of 3,149 marine fishes, representing 20 families and 64 species, were tagged and released throughout the coastal waters of Florida. A total of 762 marine fishes (24.2 percent), representing 11 families and 29 species, were returned. The state of Florida was arbitrarily divided into four zones to facilitate the tagging of fishes. These four zones were redefined for biological evaluation and the oceano-geographical characteristics of each area are discussed. According to selected reliable returns, certain offshore bottom fishes such as Epinephelus morio, Mycteroperca microlepis, and Lutjanus aya indicate very little movement in near shore locations. There are indications, however, that the above species

may show less reef specificity in the deeper offshore areas. Significant movement (over five nautical miles) was shown by the return of a few tagged individuals of the following species: Carcharhinus floridanus, Carcharhinus sp., Pomatomus saltatrix, Trachinotus carolinus, Caranx hippos, Centropomus undecimalis, and Menticirrhus saxatilis. Although very few returned fish were free long enough to yield valid growth rates, some indications of growth are presented on the following species: Centropristes striatus striatus, Mycteroperca microlepis, Lutjanus aya, Lutjanus griseus, Cynoscion nebulosus, Pogonias cromis, Sciaenops ocellata, and Archosargus probatocephalus. Fishes tagged inshore in some areas of the state were occasionally transported from the site of initial capture to another location for release. Although too few individuals were involved to correlate subsequent movement of displaced fishes with those not displaced, transport records and significant movement of some individuals of the following species are presented: Cynoscion nebulosus, Pogonias cromis, Sciaenops ocellata, and Archosargus probatocephalus. Petersen, internal anchor (body cavity), and California type spaghetti tags were used during this program. In general, Petersen disc tags were used on slow moving, laterally compressed fishes and are recommended predominantly for short term studies. Spaghetti tags give good results when used on fast swimming species such as selachians, lutjanids, pomatomids and scomberomorids. These tags can be tedious to apply but have the advantage of being more obvious to the fisherman. Internal tags work well on almost any species of fishes except those with restricted body cavities such as the carangids. Thick, overlapping ventral scales, or the presence of a thin body cavity wall will also inhibit the secure seating of this tag. Internal tags are recommended for long term studies since they will remain firmly attached to the body cavity wall, often being covered by the somatic peritoneum. These tags are easy to apply, do not hamper the natural swimming movements of the animal, and are less obvious to natural predators. One disadvantage is that the internal tag is less obvious to the fisherman at the time of capture, although a good chance exists for its discovery when the fish is gutted. (Authors summ.)

12120. Beaumariage, Dale S. (Florida Dept. of Natural Resources Marine Res. Lab., St. Petersburg, Florida). 1969. RETURNS FROM THE 1965 SCHLITZ TAGGING PROGRAM INCLUDING A CUMULATIVE ANALYSIS OF PREVIOUS RESULTS. Florida Bd. of Conservation Technical Series No. 59, 38 p.

Data received from the return of tagged individuals representing 26 of the 58 species of marine fishes released throughout Florida waters during 1965 is presented in this final report concerning these annual cooperative fish-tagging programs. Movement and growth information is recapitulated for 12 principal species of the families: Serranidae, Pomatomidae, Lutjanidae, Pomadasyidae, Sparidae, and Sciaenidae, which were tagged during the 1961-65 Schlitz and the 1963 State sponsored programs. (Auth.)

12121. Klima, Edward F., and Durbin C. Tabb (The Marine Lab., Univ. of Miami, Miami, Florida). 1959. A CONTRIBUTION TO THE BIOLOGY OF THE SPOTTED WEAKFISH, Cynoscion nebulosus, (Cuvier) FROM NORTHWEST FLORIDA, WITH A DESCRIPTION OF THE FISHERY. Florida Bd. of Conservation Technical Series No. 30, 25 p.

The three counties located in the study area, Taylor, Wakulla, and Franklin, produce approximately seven percent of the annual Florida west coast production of spotted weakfish. The commercial production of spotted weakfish is largely incidental to the catch of other fish. The commercial gears which produce this species include gill nets, trammel nets, seines and hook and lines. These gear types are selective as to size of fish caught. Gill-net-caught spotted weakfish ranged in standard length from 23.5 to 47.5 cm while fish caught by hook and line ranged in length from 17.5 to 43.6 cm. Three-, four-, and five-year-old fish are the principal year classes in this fishery. Angler catches may be sold to commercial outlets. The major portion of angler catches is taken in the winter. The marks on spotted weakfish scales are true annuli, thus allowing age and growth calculations. The maximum age of spotted weakfish observed was seven years while the average

age was between three and four years. Male fish may attain sexual maturity by the end of their first year of life; sexual maturity apparently occurs for the first time among females at the end of the second year of life. Spawning begins in the latter part of April and continues through September. There is a changing sex ratio with size. Male fish dominated the catches up to a standard length of 29.4 cm while above this length catches contained a greater percentage of females. Spotted weakfish were found to feed mainly on fish and shrimp. There are differences between the spotted weakfish from the east and northwest coasts of Florida in the rate of growth, average size of fish, length at first maturity and length of spawning season. Some possible reasons for these differences are discussed. (Authors summ.)

12122. Moe, Martin A., Jr. (Florida Bd. of Conservation Marine Lab., Maritime Base, St. Petersburg, Florida). 1966. TAGGING FISHES IN FLORIDA OFFSHORE WATERS. Florida Bd. of Conservation Technical Series No. 49, 40 p.

The Florida Board of Conservation, Salt Water Fisheries Division, Marine Laboratory, sponsored an offshore fish tagging program from February, 1963 to September, 1963. Most of the 3,596 fishes were tagged offshore of the central, west coast of Florida, although tagging sites included other coastal areas and the Florida Kays. A return of 165 fish, 4.0 percent of all tagged fish was realized. Results of this project and other recent tagging programs indicate that internal anchor and spaghetti tags have good potential for marking many reef fishes. Sea bass, Centropristes, and white grunt, Haemulon plumieri, exhibited no seasonal and only slight random movement from the tagging site. Random movements of white grunt were slightly greater than those of sea bass. Young groupers, Epinephelus morio and Mycteroperca microlepis on near-shore areas showed little movement from the tagging site, but adult E. morio tagged in 17 to 26 fathoms of water moved up to 45 miles from the tagging site. Groupers can survive the tagging ordeal in 26 fathoms of water if the swim bladder is deflated before the fish is returned to the water. King mackerel, Scomberomorus cavalla, were tagged for the first time. Although only four of the 596 fish tagged were returned, the methods and equipment used in tagging are considered to have good potential for future application. Three returns were obtained from the tagging site with apparently the lowest population density. This 6 percent return from the 52 fish tagged in the St. Petersburg area indicates the ratio of tagged to untagged fish in other areas was too low to expect recaptures. (Auth. summ.)

12123. Moe, Martin A., Jr., Raymond H. Lewis, and Robert M. Ingle (Florida Bd. of Conservation Marine Lab., Maritime Base, St. Petersburg, Florida). 1968. POMPANO MARICULTURE: PRELIMINARY DATA AND BASIC CONSIDERATIONS. Florida Bd. of Conservation Technical Series No. 55, 65 p.

Research on the environmental tolerances of pompano, Trachinotus carolinus, was conducted at Minorcan Seafood Company and at Marineland during 1967. The results of this research and the operations of the Minorcan Seafood Company are described in this paper. Some basic considerations of commercial pompano farming are also discussed. Pompano in the pond environment were 17% heavier than wild fish at the legal size of ten inches fork length. Pompano were able to adapt to a freshwater environment if the salinity was gradually reduced. Their lower temperature tolerances ranged to about 53°F; shock and death occurred below this temperature. Pompano were able to withstand complete anesthesia, extreme turbidity, extreme pH elevation and depression, and oxygen depletion down to three parts per million. A hypothetical growth curve for pompano was constructed and graphs for feeding ground fish were developed on the basis of stomach-contents weight after feeding activity. A conversion of 3.2 pounds of trout pellets to one pound of pompano was obtained from 75 to 150 mm FL fish during one month of growth. Gonadal maturation occurred in some pond fish, although there is no evidence that spawning actually took place. Experimentation showed that the growth of fry was inhibited by high assemblage levels. (Authors summ.)

12124. Sigler, William F. (Dept. of Wildlife Resources, Utah State Univ., Logan, Utah). 1969. ELECTRICITY IN FISHERY RESEARCH AND MANAGEMENT. Utah Science, Utah State Univ. pub., 30(3): 72-79.

This is a summary of current practices, in both the United States and Europe, of electrofishing as it is used in research and management. The subheadings include a review of the principles of electricity, history of electrofishing, uses of electricity in fisheries, reaction of fish to electric current, both direct and alternating, factors affecting electrofishing, the description of the physical set-up for electrofishing in streams, the hazards of electricity to fish, the physical set-up of electrofishing in lakes, and safety procedures in both streams and on lakes. In addition there is a brief discussion of electric fish screens and the use of electricity as an anesthetic. Thirty authors are cited in the bibliography, including a number from the book "Fishing with Electricity", Food and Agriculture Organization of the United Nations. The items discussed include the reason why very high conductivity or very low conductivity water requires a greater machine output than does a median-conduct water conductivity. In addition to discussing the reactions of fish to direct and alternating current, reactions to cycled currents is considered. Two nomographs from "Fishing with Electricity", Food and Agriculture Organization of the United Nations give the approximate volts, ohms, amperes and demanded machine power when the number of anodes, the size of the cathodes, and water resistivity are known. (Auth.)

12125. Volpe, Alfred V. (The Marine Lab., Univ. of Miami, Miami, Florida). 1959. ASPECTS OF THE BIOLOGY OF THE COMMON SNOOK, Centropomus undecimalis (Bloch) OF SOUTHWEST FLORIDA. Florida Bd. of Conservation Technical Series No. 31, 37 p.

Migration was studied by means of a tagging program in which different types of tags and methods of capture were used. A total of 2,068 snook were tagged in eighteen salt and brackish water areas of south Florida, and sixty-one, or 2.9 percent, were recaptured within 333 days after they were released. The beach seine proved the most efficient gear for capturing large quantities during the spawning season, and the Petersen disk tag was the most efficient of the three tags used, although it caused some tissue damage. The use of sport fishermen as taggers proved unsatisfactory, due mostly to inconsistencies in measuring and recording lengths of snook. The catch of tagged snook was about equally divided between sport and commercial fishermen. A nonmigratory pattern of behavior was observed in fifty-seven fish whose tags were returned with sufficient data to determine migration. Of these 70 percent were recaptured within five miles of the point of release, 7 percent within ten miles, 5 percent within fifteen miles, 4 percent within twenty-five miles, and 2 percent within forty miles of the point of release. Distance migrated generally did not increase with the time the fish were free. Short coastwise movements were made by four fish. Inshore movements were made by three fish during the winter, and offshore movements from a canal to the bay were made by two fish in the spring. Age and growth was determined by counting and measuring the annuli of 590 otoliths. Snook may reach the age of at least seven years. Males live as long as the females, and were found in greater number in the fishery in all age groups except the VI and VII. In these age groups there were slightly more females. Almost all snook are mature by their third year of life. The commercial catch of Collier and Lee counties from September, 1956 to May, 1957 was composed principally of two-, three-, and four-year-old snook. The growth rate of the female snook was more rapid than the growth rate of the males in all age groups. Growth to the second year (both sexes) is rapid, then is fairly uniform to the fifth year, and slowly declines thereafter. Field observations during June and early July indicated that snook spawn off the sandy beaches of passes and that the peak of spawning in 1956 was over after mid-July. An egg count of a ripe 584 mm (23 inches) snook totaled 1,440,000. The snook population of Florida is probably a small one fluctuating with changes in its ecology, but, being a relatively fast-growing early-maturing fish, it can probably maintain its abundance when conditions are normal. (Auth. Summ.)

12126. Nishiyama, Tsuneo, Takeji Fujii, Junji Yamada, and Shun Okada (Research Inst. of North Pacific Fisheries, Faculty of Fisheries, Hokkaido Univ., Japan). 1968. MEAN FORK LENGTH AND NUMBER OF SCALE CIRCULI OF CHUM SALMON GROUPS IN THE GULF OF ANADYR AND ADJACENT HIGH SEAS IN LATE JULY 1966. Bull. Fac. Fish. Hokkaido, 19(2): 63-75.

Fork length and number of scale circuli of three- and four-year-old chum salmon, which were captured in the Gulf of Anadyr, off the Gulf of Anadyr, and off Cape Navarin during late July in 1966, were analyzed in relation to distribution of the population in the northern part of the Bering Sea. Three peculiar values were obtained in mean fork length that corresponded to the respective sea areas, whereas the mean number of scale circuli designated two groups in the above sea areas. Similarity of the mean number of scale circuli implies that the fish groups in the waters off the Gulf of Anadyr and the fish groups off Cape Navarin derive from the same population. The fish groups in the Gulf of Anadyr differed from the above fish groups in both mean fork length and number of scale circuli, and were regarded as coming from a different population than the other groups. (Authors summ.)

12127. Imura, Koji, and Tsuneyuki Saito (Lab. of Biochemistry, Faculty of Fisheries, Hokkaido Univ., Japan). 1968. NUCLEIC ACID CONTENTS IN VARIOUS TISSUES OF SOME FISHES. Bull. Fac. Fish. Hokkaido, 19(2): 132-139.

The nucleic acid contents in various tissues of some fishes were estimated by the Schmidt & Thannhauser method. A large amount of RNA was found in the liver and pyloric caeca, while DNA was predominantly found in the spleen, kidney, milt and blood as compared with other tissues. Especially in the blood most of the nucleic acid was estimated as DNA. The liver of the female dog salmon with a mature ovary has about three times as much RNA content as the male one. This may be compared with the fact that the RNA content in the liver of mammals increases during pregnancy. In the spleen, kidney and milt, more inorganic phosphorus was found in the DNA fraction than in the RNA fraction. A large amount of phosphoprotein was found in the mature ovary of the rainbow trout, while it could not be detected as such in the immature ovary of the carp. (Authors)

12128. Ushiyama, Hiroshi (Lab. of Biochemistry, Faculty of Fisheries, Hokkaido Univ., Japan). 1968. STUDIES ON THE PROTEOLYTIC ENZYMES OF THE SALMON PYLORIC CAECA. II. PURIFICATION AND SOME PROPERTIES OF TRYPSIN-LIKE ENZYMES. Bull. Fac. Fish. Hokkaido, 19(2): 147-155.

Two proteolytic enzymes hydrolyzing benzoyl-L-arginineamide (BAA) to benzoyl-L-arginine and ammonia were obtained from the pyloric caeca of the salmon, Oncorhynchus keta, by the following procedure: (1) extraction at pH 5.0, (2) autocatalytic activation at pH 8.0-8.5, (3) fractionation with ammonium sulphate, (4) decolorization with Duolite A-2 and (5) chromatography on DEAE-cellulose. These enzymes were designated as salmon trypsin-like enzyme 1 and 2 (ST_1 and ST_2), and purified about 25 and 16 fold, respectively. With electrophoresis on cellulose acetate strips (Separax), ST_1 migrated at pH 8.6 toward the cathode at a slower rate than bovine α-chymotrypsin and trypsin. Both enzymes were unstable below pH 5.5 at 35°C. ST_1 and ST_2 exhibited maximum activity at pH 8.2 and 8.5, and were unstable at a temperature above 40 and 30°C. Michael's constant was 1.57 and 1.45 mM for BAA. Both enzymes were slightly activated by Mn^{2+}, Ca^{2+}, Mg^{2+}, Ba^{2+} and some reducing agents, but strongly inhibited by Cu^{2+}, Ag^{+} and Hg^{2+}, and practically unaffected by EDTA and PCMB. In experiments with the natural trypsin inhibitors, soybean trypsin inhibitor (12 μg/ml) inhibited ST_1 and ST_2 to the extent of 95 and 77%, and ovomucoid (3 μg/ml), 97 and 77%, respectively. From these results, it was concluded that the enzymes were a proteinase of the trypsin type. (Auth.)

12129. Heemstra, Phillip C. 1965. A FIELD KEY TO THE FLORIDA SHARKS. Florida Bd. of Conservation Technical Series No. 45, 11 p.

12130. Koch, H. J. A., E. Bergstrom, E. Bodarwe-Schmitz, and J. C. Evans (Zoological Inst. of the Univ., Leuven (Louvain) Belgium and Laxforskningsinstitutet, Alvkarleo, Sweden). 1968. THE SEPARATION OF THE HAEMOGLOBINS OF Salmo salar L. BY MEANS OF ISOELECTRIC FOCUSING. Mededel. Vlaamse Acad. Kl. Wet., 30(20): 1-16.

The separation by means of isoelectric focusing in a natural pH gradient according to the method of H. Svensson has been applied to the de-ionised haemolysate of the erythrocytes of Salmo salar L.. By means of this method it is possible to separate and to characterize in carboxy-form a large number of molecular species of haemoglobins on the basis of their respective isoelectric points. These extend between pH 5.9 and 9.0 in big specimens. (Authors)

12131. Koch, H. J. A., N. P. Wilkins, E. Bergstrom, and J. C. Evans (Zoological Institute of the Univ., Leuven (Louvain), Belgium and Dept. of Agriculture and Fisheries for Scotland, Marine Lab., Aberdeen, Scotland). 1967. FURTHER STUDIES ON THE MULTIPLE COMPONENTS OF THE HAEMOGLOBINS OF Salmo salar L. Mededel. Vlaamse Acad. Kl. Wet., 29(7): 1-16.

When analysed on starch gel, with the same buffer, the ontogenetic electrophoretic patterns obtained with the haemoglobins of Salmo salar L. of Scottish and Scandinavian origin correspond. The appearance of these patterns is influenced by the ionic strength of the buffer used. Macro and micro electrophoresis techniques give the same results. Maximal resolution of the anodic components is obtained with a modified Tris-boric acid-citric acid-lithium hydroxide buffer. Tris HCl buffer provides maximal separation of the cathodic components. (Authors)

12132. Kosaka, Sunao, and Teruo Ishida (Nanae Fish-Culture Experimental Sta., Faculty of Fisheries, Hokkaido Univ., Japan). 1969. A NOTE ON THE ECOLOGY OF JUVENILE Masu SALMON, Oncorhynchus masou IN A BROOK. Bull. Fac. Fish. Hokkaido, 20(2): 65-74. (In Japanese with English abstract).

A study on the distribution, emigration, growth, precocious maturity and abundance of juvenile Masu salmon, including both hatchery-cultured and naturally spawned fish, was made in a small brook near Hakodate, Hokkaido. Most of the hatchery-cultured fry, liberated in section II, moved upstream during the period from late April to early June. A tendency of further movement upstream was also recognized in a small number of the hatchery-cultured fish during this period. Both groups of fish were distributed more or less evenly in the brook. The naturally spawned fish were larger in size than the hatchery-cultured fish until early July; thereafter the latter showed greater growth than the former. The size of the fish belonging to the two groups became approximately equal in September. Their specific growth rate decreases gradually as the fish grow. The percentage of precocious males, captured in the brook in the month of September, was found to be 36.8% of the total capture. Abundance of fish in the brook was estimated from the recapture of marked fish. (Authors)

12133. Slatick, Emil (Bur. of Comm. Fisheries Biological Lab., Seattle, Wash.) 1970. PASSAGE OF ADULT SALMON AND TROUT THROUGH PIPES. U. S. Dept. of the Interior, Bur. of Comm. Fisheries Special Scientific Report No. 592, 18 p.

Pipes, which are relatively inexpensive and easily installed, are an economical and efficient solution to certain problems of fish passage at dams and at other obstacles blocking migratory routes. The purposes of this study (1963-64) were to determine: (1) if adult salmon and trout at Bonneville Dam on the Columbia River would use a pipe as a passageway and (2) how the conditions at the entrance and within the pipe, diameter and length, illumination, and flow would influence passage. The pipes were 0.3, 0.6, and 0.9 m. in diameter and were 27.4 to 82.3 m. long. Chinook salmon (Oncorhynchus tshawytscha), sockeye salmon (O. nerka), coho salmon (O. kisutch), and steelhead trout (Salmo gairdneri) passed through unilluminated pipes up to 82.3 m. long. Of the four species tested, only steelhead trout appeared to benefit appreciably from illumination. For distances up to 82.3 m., a 0.6-m.-diameter pipe was large enough to pass all salmon and trout. The fish passed through a 0.6-m.-diameter pipe when it was flooded or partly filled with

water, but did not readily enter a 0.3-m. pipe until special conditions of water velocity and transition from pool to pipe were provided. (Auth.)

12134. Dean, Jack L. (Div. of Fishery Services, Bur. of Sport Fisheries and Wildlife). 1969. BIOLOGY OF THE CRAYFISH Orconectes causeyi AND ITS USE FOR CONTROL OF AQUATIC WEEDS IN TROUT LAKES. U. S. Dept. of the Interior, Bur. of Sport Fisheries and Wildlife Technical Paper No. 24, 15 p.

Submerged aquatic plants limit the suitability for trout management of many shallow lakes in the Southwest. Control of these weeds has been achieved by the introduced crayfish Orconectes causeyi. The life history, ecology, and weed-control activities of this crayfish are discussed. Abundant crayfish populations occur over a wide range of elevations in permanent well-oxygenated ponds, lakes, and streams where predaceous warm-water fishes are scarce. Weed control is proportional to the crayfish population and the proximity of a rocky substrate which is preferred habitat. This crayfish controls several species of Potamogeton, Myriophyllum, Elodea, Ceratophyllum, Ranunculus, Chara, and filamentous algae. It does not control Scirpus, Typha, or Polygonum. Eggs are laid from late March to early May, depending on water temperatures. They hatch from late May through June after being carried 6 to 9 weeks, and the young remain attached to the adult female 7 to 12 days before becoming free living. Sexual maturity is attained between August and mid-September of the second summer at an age of 14 or 15 months. Many females die when 24 or 25 months old, after producing their first brood, but a few survive to produce a second brood. Ovarian egg production averages 588, which is greater than that of any other North American crayfish reported in the literature. The sex ratio is 1:1 for immature individuals, but adult males outnumber adult females 1.5:1. This crayfish is a tertiary burrower establishing relatively shallow burrows for hibernation and egg-hatching periods. It has not damaged dams or irrigation ditches and has been compatible with local agriculture. (Auth.)

12135. Guilford, Harry G. (Univ. of Wisconsin Center, Green Bay, Wisconsin). 1965. NEW SPECIES OF MYXOSPORIDIA FROM GREEN BAY (LAKE MICHIGAN). Trans. Amer. micr. Soc., 84(4): 566-572.

Several species of small fishes, collected principally during the spring and summers of 1962 or 1963 from tributaries or the shorelines of Green Bay (Lake Michigan), were examined for Myxosporidia. Five new species: Henneguya umbri Sp. Nov. from the gills of Umbra limi, Myxobilatus noturi Sp. Nov. from the urinary bladder of Noturus gyrinus, Myxobilatus cotti Sp. Nov. from the urinary bladder of Cottus bairdi, Myxosoma eucalii Sp. Nov. from the skeleton of Eucalia inconstans, and Myxidium umbri Sp. Nov. from the renal tubules of Umbra limi, are described. Myxosoma procercum Kudo from trout-perch, Myxidium sp. from the gall bladder of Umbra limi, and Myxidium lieberkuehni Butschli from pike are also recorded in Green Bay. (Auth. summ.)

12136. Calentine, Robert L., and John S. Mackiewicz (Wisconsin State Univ., River Falls, Wisconsin). 1966. Monobothrium ulmeri N. SP. (CESTODA: CARYOPHYLLAEIDAE) FROM NORTH AMERICAN CATOSTOMIDAE. Trans. Amer. micr. Soc., 85(4): 516-520.

A caryophyllaeid cestode, Monobothrium ulmeri n. sp., is described from three species of catostomid fishes. The oligochaete annelid Limnodrilus hoffmeisteri serves as the intermediate host; procercoid development is described and a key to the North American species of Monobothrium is presented. (Authors)

12137. Meyer, Marvin C. (Dept. of Zoology, University of Maine, Orono, Maine). 1967. HATCHING OF Diphyllobothrium sebago EGGS IN NATURE. Trans. Amer. micr. Soc., 86(3): 239-243.

When eggs of the pseudophyllidean Diphyllobothrium sebago were tested under conditions simulating those in nature and examined at spaced intervals, hatching occurred. Within 9-20 C and to a depth level of 90 ft the percentage of eggs hatching increased with exposure. The effects of water temperature and depth on the hatching of Diphyllobothrium eggs are discussed. (Auth.)

12138. Corkum, Kenneth C. (Dept. of Zoology and Physiology, Louisiana State Univ., Baton Rouge, Louisiana). 1967. BUCEPHALIDAE (TREMATODA) IN FISHES OF THE NORTHERN GULF OF MEXICO: Bucephalus Baer, 1827. Trans. Amer. micr. Soc., 86(1): 44-49.

A total of 614 fishes representing 103 species from the northern Gulf of Mexico were examined for infections of trematodes in the family Bucephalidae. Five species of Bucephalus Baer, 1827, were collected. One new species is described and the description of B. cynoscion Hopkins, 1956, and B. gorgon (Linton, 1905) Eckmann, 1932, augmented. New locality records are also given for B. gorgon, B. scorpaenae Manter, 1940, and B. varicus Manter, 1940. (Auth.)

12139. Saunders, Dorothy Chapman (Mote Marine Lab., Siesta Key, Sarasota, Florida). 1968. VARIATIONS IN THROMBOCYTES AND SMALL LYMPHOCYTES FOUND IN THE CIRCULATING BLOOD OF MARINE FISHES. Trans. Amer. micr. Soc., 87(1): 39-43.

Methods of distinguishing small lymphocytes from thrombocytes in the circulating blood of marine fishes are discussed. The literature commonly gives descriptions only of typical mature cells of each type. However, the circulating blood contains juvenile and senile degenerating stages as well, which have quite different structural and staining properties. A series of illustrations is given, showing these other stages commonly found in the circulating blood. (Auth.)

12140. Corkum, Kenneth C. (Dept. of Zoology and Physiology, Louisiana State Univ., Baton Rouge, Louisiana). 1968. BUCEPHALIDAE (TREMATODA) IN FISHES OF THE NORTHERN GULF OF MEXICO: Bucephaloides Hopkins, 1954, AND Rhipidocotyle Diesing, 1858. Trans. Amer. micr. Soc., 87(3): 342-349.

Nine species of the genus Bucephaloides and eight of Rhipidocotyle were found in a survey of 103 fish species from the northern Gulf of Mexico. One new species in each of the genera is described and new locality records are given for B. caecorum, B. callicotyle, B. longicirrus, B. longoviferus, B. megacirrus, B. trichiuri, R. adbaculum, R. anqusticolle, R. longleyi, and R. nagatyi. New host records are reported for R. adbaculum and R. anqusticolle.

12141. FAO, Marine Biology and Environment Branch, Fishery Resources and Exploitation Division. 1969. SYMPOSIUM ON INVESTIGATIONS AND RESOURCES OF THE CARIBBEAN SEA AND ADJACENT REGIONS, PREPARATORY TO THE COOPERATIVE INVESTIGATION IN THE CARIBBEAN AND ADJACENT REGIONS (CICAR) ORGANIZED THROUGH THE JOINT EFFORTS OF FAO AND UNESCO. WILLEMSTAD, CURACAO, NETHERLANDS ANTILLES, 18 - 26 NOVEMBER 1968. REPORT AND ABSTRACTS OF PAPERS. FAO Fisheries Report No. 71.1.

This publication forms part of the Proceedings of the Symposium on Investigations and Resources of the Caribbean Sea and Adjacent Regions organized jointly by UNESCO and FAO and co-sponsored by WMO, held in Willemstad, Curacao, from 18 to 26 November 1968. The symposium was preparatory to the Cooperative Investigations in the Caribbean and Adjacent Regions (CICAR) which will start in 1970 under the aegis of the Intergovernmental Oceanographic Commission. The present volume, issued by FAO in its FAO Fisheries Reports series, contains the report and abstracts of papers contributed to the symposium. The material in it was compiled and edited by G. Saetersdal, Acting Chief, Marine Biology and Environment Branch, Fishery Resources and Exploitation Division, with the assistance of the Office of Oceanography of UNESCO. The full texts in their original language of the papers contributed to the Fishery Resources Section of the Symposium will be issued by FAO in the same series. The integral texts of the contributions to the Symposium sections on Physical and Chemical Oceanography, Marine Geology and Geophysics and Marine Biology, will be published by UNESCO. The views expressed in this report and in the contributed papers are those of the authors and do not necessarily reflect the policies of the sponsoring agencies. (Editorial note)

12142. Blacker, R. W. (Fisheries Lab., Lowestoft, England). 1964. ELECTRONIC FLASH PHOTOGRAPHY OF GADOID OTOLITHS. International Comm. for the Northwest Atlantic Fisheries Research Bull. No. 1, pp. 36-38.

A simple apparatus and method for photographing otoliths is described, using a 35 mm single-lens reflex camera with a specially designed otolith mount and ring flash illumination. (Auth.)

12143. Messtorff, J. (Institut für Seefischerei, Aussenstelle Bremerhaven, Federal Republic of Germany). 1964. A METHOD OF PREPARING PHOTOGRAPHS AND TRANSPARENCIES OF COD OTOLITHS. International Comm. for the Northwest Atlantic Fisheries Research Bull. No. 1, pp. 82-84.

A photographic technique of preparing satisfactory black and white transparencies and prints of cod otolith structures, is described and two examples are given. A corresponding set of transparencies have been successfully demonstrated to experts. The results, obtained by this technique, show rather the same pictures of otolith structures as at microscopic viewing under the usual conditions, but have the advantage of enabling several people to examine and discuss the same otolith at the same time. (Auth.)

12144. Hiroi, Osamu, and Kiichiro Yamamoto (Lab. of Freshwater Fish Culture, Faculty of Fisheries, Hokkaido Univ., Japan). 1968. STUDIES ON THE MATURATION OF SALMONID FISHES - I. CHANGES IN THE TESTIS OF THE CHUM SALMON, Oncorhynchus keta, DURING ANADROMOUS MIGRATION. Bull. Fac. Fish. Hokkaido, 19(3): 173-184, plates.

Changes in the testes of the chum salmon, Oncorhynchus keta, during the anadromous migration are investigated in the present study. The course of maturation in this species proceeds synchronously in all of the germ cells within a cyst. Although phases in the spermatogenesis are generally different from cyst to cyst in a testicular lobule, the maturation of the testis seems to be advanced quite synchronously in all the lobules. The testes have already been maturing at the time of commencement of anadromous migration: germ cells of every maturational stage from primary spermatocytes to mature spermatozoa are seen in these testes, while spermatogonia have passed through the multiplication phase at that time. The spermatogonia, spermatocytes and spermatids become indetectable in turn within their testicular lobules associated with the progress of anadromous migration, though a few spermatogonia bearing some deformation are occasionally seen in mature testes. Spermatozoa are accumulated in the lumen of the testicular lobules without any regularity in arrangement, being separated by a narrow space from the periphery of the lobule. The intralobular somatic cells lining the lobule wall show cytoplasmic vacuolization during the period of active spermiogenesis, suggesting development of a glandular nature in these cells. The interstitial cells of the testis appear to reveal some changes during the anadromous migration but not so marked. The testis tends to decrease in weight during the course of anadromous migration before they reach functional ripening. The testicular maturity represented in terms of the relative amount of mature spermatozoa to total germ cells shows a marked increase in value with the progress of the anadromous migration, indicating a rapid maturation of the testis in the freshwater stages of the migration. (Authors summ.)

12145. Sundnes, Gunnar (Fiskeridirektoratets Havforskningsinstitutt, Bergen, Norway) 1963. STUDIES ON THE HIGH NITROGEN CONTENT IN THE PHYSOSTOME SWIMBLADDER. FiskDir. Skr. Ser. HavUnders., 13(5): 8 p.

The high nitrogen content in the swimbladder of some coregonid and salmonid fishes has been studied in relation to their different biology and migration. That these fish are found to have high oxygen contents at certain times supports the theory that the gas deposition mixture consists mainly of oxygen. It is suggested that the high nitrogen content often seen is a result of a preferential oxygen absorption by the swimbladder tissue. (Auth. summ.)

12146. Sundnes, Gunnar (Fiskeridirektoratets Havforskningsinstitutt, Bergen, Norway). 1962. A PRESSURE AQUARIUM FOR EXPERIMENTAL USE. FiskDir. Skr. Ser. HavUnders., 13(4): 7 p.

12147. Hughes, George M. (Dept. of Zoology, The Univ., Bristol, England). 1970. A COMPARATIVE APPROACH TO FISH RESPIRATION. Experientia, 26(2): 113-122.

A general view of new investigations is given in regard to the broad functional sphere of the mechanism of fish respiration. Emphasis is placed on the comparative aspect of one such research study in which it is shown that the choice of a particular species can throw a beneficial light on the general important problems which occur in gill studies, not only at the macro-structure stage but also at the ultra-structure stage. From the physiological standpoint, certain species proved to be especially suited for experimental studies of their oxygen consumption, on the basis of their way of life. The structural arrangement of the pump mechanism of other species facilitates again extremely advantageously the direct measurement of ventilation volume and other gas-exchange-related parameters. (Auth. summ.) Translated from the German by Robert M. Howland.

12148. Bertmar, Gunnar, and Rolf Toft (Dept. of Biology, Section of Ecological Zoology, Univ. of Umeå, Umeå, Sweden). 1969. SENSORY MECHANISMS OF HOMING IN SALMONID FISH - I. INTRODUCTORY EXPERIMENTS ON THE OLFACTORY SENSE IN GRILSE OF BALTIC SALMON (Salmo salar). Behaviour, Vol. 35, parts 3-4, pp. 235-241.

'Grilse' of Baltic salmon are young sexually mature fish, mostly males. In 191 'grilse' of River Indalsälven the olfactory sense was eliminated and then the fish were released in the Sundsvall Bay Area 35-40 km north and south of the home river. Most of these fishes failed to orient toward home during spawning time, whereas many of the 100 control animals, traumatized on the nose, homed as readily as did many of the 100 untreated controls released in the same places. These results indicate an important role for olfaction in homing behaviour and migration in Baltic salmon. (Authors summ.)

12149. Kariya, Teiji, Hideo Haga, Yoshiko Haga, and Kunihiko Kimura (Dept. Fish Fac. Agr. Tohoku Univ., Sendai, Japan). 1969. STUDIES ON THE POST-MORTEM IDENTIFICATION OF THE POLLUTANT IN FISH KILLED BY WATER POLLUTION - X. ACUTE POISONING WITH LEAD. Bull. Jap. Soc. sci. Fish., 35(12): 1167-1171. (In Japanese with English abstract).

In this study, we attempted to detect lead in the body of rainbow trout killed by acute lead poisoning. A lead solution (lead nitrate) of 3 ppm was found to be fatal to rainbow trout in 23-24 hours and the 48 h Tlm was found between 1 and 3 ppm Pb. It was found that the nature of the water used for preparing the lead solution influences considerably the toxicity of lead. The use of hard water (2.0 meq/l alkalinity) resulted in a great reduction of the toxicity. Lead content of tissues was determined by the Diphenylthiocarbazone method. Lead levels of the control fish were less than 0.34 γ/g Pb and 0.25 γ/g Pb on an average. Lead content of fish killed by lead solutions was higher than that of the control fish. When the body of fish was washed with running tap water for 24 hours after death, lead content decreased to 60.2-95.5% of the initial values. Seven parts of the fish body were examined for distribution of lead in two cases. In the first case, fish were killed by a lead solution and in the second, fish were soaked in a lead solution after death by suffocation. In both cases the gills showed the highest value of lead content among the seven parts and the muscles showed the lowest. Lead content of the gill was higher in the first case than in the second case. It was of interest to note that lead was detected scantily in the liver and alimentary canal in the second case. It should be pointed out that in the diagnosis of lead poisoning it is important to know the distribution of lead in the carcass. (Authors)

12150. Wahlquist, Harold. 1966. A FIELD KEY TO THE BATOID FISHES (SAWFISHES, GUITARFISHES, SKATES AND RAYS) OF FLORIDA AND ADJACENT WATERS. Florida Bd. of Conservation, Division of Salt Water Fisheries, Technical Series No. 50, 20 p.

12151. Kariya, Teiji, Shuko Eto, Norio Yamaguchi, and Kaoru Suzuki (Dept. Fish. Fac. Agr., Tohoku Univ. Kita-6, Sendai, Japan). 1969. STUDIES ON THE POST-MORTEM IDENTIFICATION OF THE POLLUTANT IN FISH KILLED BY WATER POLLUTION - XI. ON ACUTE POISONING WITH TIN PLATING SOLUTIONS. Bull. Jap. Soc. sci. Fish., 35(12): 1172-1178. (In Japanese with English abstract).

In this paper, an attempt was made to detect Sn in the body of fish (Carassius auratus) killed by tin plating solutions. Sn content of tissues was determined by the phenylfluorone method. In tin plating, two kinds of plating solutions are commonly used, viz. alkaline and acid. Experiments showed that the 48 hour median tolerance limits of these 2 kinds of tin plating solutions to goldfish were approximately 100 ppm Sn. Sn was not detected in control fish bodies, but was clearly detected in the bodies of fish killed by either of the two kinds of solutions. The bodies of fish, killed by tin plating solutions showed values higher than 13.0 γ/g Sn, while the bodies of fish still living in tin plating solutions showed values lower than that. It was also possible to detect Sn even in fish washed by running tap water for 24 hours after death. The distribution of tin in seven parts of the fish body was examined under two conditions. Sn was detected in all the parts examined under the condition that fish were killed by tin plating solutions. Under the other condition, the fish were soaked in tin plating solutions for 15-24 hours after being killed by suffocation. Sn was detected in skin, gill and muscle, but not in the spleen, hepatopancreas and kidney. The bodies of fish killed by solutions containing organic tin compounds showed very low values of tin content as compared with fish killed by tin plating solutions. (Authors)

12152. Sakaguchi, Hiromi, and Akira Hamaguchi (Fish Exp. St. Hyogo Pref., Nakasaki-machi, Akashi, Japan). 1969. INFLUENCE OF OXIDIZED OIL AND VITAMIN E ON THE CULTURE OF YELLOWTAIL. Bull. Jap. Soc. sci. Fish., 35(12): 1207-1214. (In Japanese with English abstract).

In a previous paper, the effect of antioxidant treated sand-eel as food for yellowtail was reported. Thereafter, we investigated the effects of oxidized oil and vitamin E administration on yellowtail fed with artificial diets. Fish were fed for 93 days with diets containing 8.5% of fresh or oxidized cod liver oil to which DL-α-tocopheryl acetate was either added or not. The fish fed with oxidized oil, without the addition of vitamin E, showed a slightly poorer appetite after about 40 days of feeding, and at the termination of the experiment a wasting of the dorsal muscle was observed in about 10% of the fish. These symptoms are probably due to muscle dystrophy as reported for carp. However such symptoms were not found in the vitamin E supplemented group. The muscle of fish fed with oxidized oil but without the addition of vitamin E showed a slightly higher TBA value than that of the vitamin E supplemented fish, but there was no extreme difference in the TBA values of the hepatopancreas of these two groups. At the termination of the experiment, the glycogen content in the hepatopancreas of groups 1, 2, and 4 was elevated about two times, compared to its content at the 70th day. However, such elevation of the glycogen level was not seen in the group fed with oxidized oil. The activities of transaminases (GOT, GPT) were higher in the fish fed with oxidized oil than the fish fed with fresh oil and these enzyme activities could not be reduced even by the administration of vitamin E. The alkaline phosphatase activity showed little if any difference between these groups. (Authors)

12153. Meister, Alfred L. (Atlantic Sea Run Salmon Commission, Maine). 1969. CONSERVATION OF THE ATLANTIC SALMON IN THE STATE OF MAINE. The Atlantic Salmon Journal, No. 3, pp. 11-17.

In Maine the commercial landings of salmon decreased from 152,700 pounds in 1889 to approximately 11,000 pounds in the mid-1940's. At the end of World War II there was a reawakening of interest in natural resources. Public clamor culminated in Maine with the creation of the present Atlantic Sea Run Salmon Commission. The Commission was formally charged with restoration and management of the Atlantic salmon in the State of Maine. One of the first duties of the Commission was the cessation of commercial fishing in the bays and estuaries of the remaining salmon streams, and a daily limit of two salmon was imposed on the angler. Next,

an inventory of the streams and lakes of Maine was made. Initial restoration efforts were not sufficiently successful; biological data were then accumulated on the Atlantic salmon. Improvements were made in hatchery rearing techniques and returns of hatchery stock improved and a definite correlation between size at release and percentage returns was established. The larger the fish the higher the returns to the river. The use of native brood stock decreased the proportion of grilse encountered in the returning adults and fish became available to the anglers. The chain pickerel (Esox niger), and the double-crested cormorant (Phalocrocorax auritus), have been shown to be serious predators on smolts. Migration routes are becoming established through tag returns of both smolts and adults. In the management field, additional activities of note include the construction of fishways on the Penobscot and St. Croix Rivers. Pollution abatement programs are currently lagging in the New England States. Industry, with respect to fish life, remains as the greatest offender in the field of water pollution. Restoration of Atlantic salmon in the streams of Maine is a reality; however, efforts must be extended to protect the Atlantic salmon in the international arena. -- Robert M. Howland.

12154. Fraser, T. B. 1969. ANALYSIS OF THE RELEASE BY THE ROYAL DANISH EMBASSY IN LONDON, ENTITLED: "THE DANISH CATCHES OF ATLANTIC SALMON". The Atlantic Salmon Journal, No. 3, pp. 3-7.

This release opens with the following statement: "The recent decline of the salmon population in British rivers has caused great concern amongst British anglers. It seems to be a widely held view that the main cause for this decline is the Danish netting of the Atlantic salmon. The Danish Embassy has received letters of protest, in some instances combined with notices of boycott of Danish products until Denmark agrees to a ban of fishing of salmon on the high seas." The total catches of salmon, (not including grilse) in the home waters of the British Isles, Canada and Norway has dropped by 17% from 1967 to 1968. The 1969 figures will reflect a further drop. During the same years (1967-1968) the high seas catch by the Danes and their dependents increased from 227 metric tons to 606 metric tons, for an increase of 270%. Item 2) Page 1: "It seems to be generally accepted by the experts that the acute decline in several Scottish (and other British) rivers over the last year or two has been caused by the spread of the fish disease U. D. N." The U. D. N. disease has certainly reduced the number of British salmon; however, less than 15% of the fish in the rivers are attacked. The Danish fisheries no doubt have contributed to the decline of the salmon in the U. K. and also in Canada and Norway, where the decline cannot be attributed to U. D. N. The Danes contribute nothing to sustain the salmon and since the salmon is a fish born in fresh water, lives most of its life in fresh water, and feeds in an ocean in which Britain has a great stake along with sixteen other ICNAF-NEAFC countries, it is doubtful whether the Danes have any reasonable right to take these salmon on the high seas. They do have a right to take them within their own Greenland territorial waters where the British salmon are feeding upon Danish territorial shrimp. -- Robert M. Howland.

12155. Shimizu, Chiaki, Kenji Abe, and Fumio Matsuura (Lab. of Marine Biochem. Fac. of Agr., The Univ. of Tokyo, Tokyo, Japan). 1969. LEVELS OF OXIDIZED AND REDUCED NICOTINAMIDE-ADENINE DINUCLEOTIDES IN FISH TISSUES. Bull. Jap. Soc. sci. Fish., 35(10): 1034-1040 (In Japanese; figures, tables, and summary in English); Commercial Fisheries Abstracts, 23(3): p. 15.

This report presents data on the concentration of NAD, NADH (nicotinamide adenine dinucleotide and its reduced form), NADP, and NADPH (nicotinamide adenine dinucleotide phosphate and its reduced form) in the various tissues of fish. Twenty-two fish were examined. The total amount of NAD and NADH in the regular muscle of the fish was about 20 mg. percent and was several times greater than the total amount of NADP and NADPH. The total amount of each coenzyme in the red (dark) muscle of the fish was more than twice that in the regular muscle. The total amount of each coenzyme in the internal organs (liver, kidney, heart) was several times that in the regular muscle. The authors indicated that each coenzyme was found to exist in the tissues generally in the reduced form. This condition may be characteristic for fishes. -- F. T. Piskur.

12156. Mishima, Seikichi, and Kenji Shimazaki (Research Inst. of North Pacific Fisheries, Hokkaido Univ., Japan). 1969. ON THE SCHOOLING BEHAVIOUR OF SALMON. Bull. Fac. Fish. Hokkaido, 19(4): 261-272.

An effective method is needed to capture a fish school on the fishing grounds, wherein clarification of the ecological features of the fish is very important. It is often said that salmon do not form as dense a school as saury and mackerel. Therefore, it is difficult to detect a school of salmon by visual means or sonar. But in the hauling of salmon gill-nets, many individuals can be seen partially netted. It appears that salmon do not swim alone during their migration. In a previous paper, the authors reported on the netting tendencies of salmon and pointed out that the netting peaks in abundance of salmon occur twice a night, and also the time change of the spatial distribution of pink salmon. They assumed that these phenomena could be related to the swimming behaviour of the fish in their vertical movement. In the present paper they ascertain the schooling behaviour of salmon (chum and pink salmon) from the data obtained by commercial fishing, and then discuss the nocturnal change of schooling tendencies of pink salmon from the data obtained by the repeated-fishing method. Fish which were netted from the same direction at a distance of about 50 cm between individuals were regarded as a school. Experiments were carried out from the middle of May to early August in the Northwest Pacific and in the Okhotsk Sea in 1965. Commercial fishing was conducted at 18 stations in the Northwest Pacific and at 3 stations in the Okhotsk Sea using a gill-net having several mesh sizes (93, 100, 106, 112, 115, 121 and 130 mm). Repeated fishing was carried out at 1 station in the Northwest Pacific and at 6 stations in the Okhotsk Sea using a drift-net having 100, 106, 112 and 115 mm mesh sizes. A supplemental experiment was carried out at 1 station in early August in the Okhotsk Sea using 92 tans of net having 121 mm mesh size. Frequency distributions of schooling salmon as determined by commercial fishing are: Schools of chum salmon of 3 individuals occur dominantly in both sea areas, but in the Okhotsk Sea the frequency of each school was different according to the mesh sizes of the nets. Large schools of more than 12 individuals were not found. Schools of pink salmon of 2 individuals occur frequently in both sea areas, but schools of 4, 6 and 8 individuals were dominant in the North Pacific. Schools of 6 individuals and less are rather frequent in the Okhotsk Sea. Schools of pink salmon of 2 individuals generally occurred most frequently at the 7 stations by the repeated-fishing method. Most schools were composed of 6 individuals and less. The character of schooling of pink salmon is conspicuous by the time ratio 0.1 and 0.9 occurring at night, but at about midnight the ratio becomes very low. It is concluded that schools of pink salmon are conspicuous at the time when the fish come to the surface or submerge into midwater, revealing an ecological feature of pink salmon during their vertical movement. (Authors)

12157. Mount, Donald I., and Harvey W. Boyle (National Water Quality Laboratory Duluth, Minnesota). 1969. PARATHION--USE OF BLOOD CONCENTRATION TO DIAGNOSE MORTALITY OF FISH. Environmental Science and Technology, 3(11): 1183-1185; Commercial Fisheries Abstracts, 23(3), p. 17.

Diagnosis of specific causes of fish kills is often difficult. The present paper reports on the measurement of blood concentration of parathion as a diagnostic tool to detect fish mortality caused by acute exposure of the fish to parathion dissolved in water. Catfish, Ictalurus nebulosus (LeSueur), were exposed to various concentrations of technical grade parathion (80 percent active) dissolved in water for periods of up to 30 days. The concentration of parathion in the blood correlated with that found in the water. Diagnosis of mortalities of catfish caused by acute exposure to parathion can be made by measuring the amount of unaltered parathion in the blood. Further research is necessary to determine if the method applies to other species of fish and to determine whether parathion occurs in higher concentrations in the muscle than in the blood. -- F. T. Piskur.

12158. Lackey, Robert T. 1968. VERTICAL GILL NETS FOR STUDYING DEPTH DISTRIBUTION OF SMALL FISH. Trans. Amer. Fish. Soc., 97(3): 296-299.

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As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States -- now and in the future.